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Preface

The *Concept of Operations for AIT in an Automated Maintenance Environment for Army Weapon Systems* is the result of collaborative research and analysis by a carefully assembled team. This team was assembled to represent the overall Army weapon system support structure. Participants included representation from the weapons systems manufacturing industry, the maintenance management software development industry, the research and development office of the Army Aviation and Missile Command, a weapon system program manager's office, and Logistics Management Institute (LMI), an independent research and analysis firm.

Although the document stands as a collaborative effort, credit must be given to contributions provided by the individual team members outside of LMI. Without these substantive contributions from their respective areas of expertise, this document would not have been possible.

The research and effort for this document was made possible by funding from the Logistics Integration Agency. The Army Aviation Applied Technology Directorate managed the contractual arrangements and LMI coordinated the team's effort.

Foreword

A companion Executive Summary volume (Volume 1) provides a high-level synopsis of the concepts and approaches described in this Concept of Operations for AIT in an automated maintenance environment for Army weapon systems.

Chapter 1
Introduction

Success of the Army's transformation plans relies heavily on achieving greater efficiency from maintenance processes. Current maintenance management processes have changed little since inception decades ago—when manpower was plentiful and decision-making was on par with the speed that paper could pass through the system. The combat commander's ability to be proactive and plan for future events is severely limited by these legacy processes and systems. Too often, tactical decisions are based on empirical assumptions because the information needed to support decisions is not integrated, difficult to access, and woefully outdated.

This Concept of Operations (hereafter referred to as the "Con-Ops") for automatic identification technology (AIT) for Army weapon systems describes how an automated maintenance environment (AME) and its associated application of AIT can enable a new paradigm for weapon system management. It describes how AIT is an integral part of the AME and necessary to attain the benefits of an automated environment.

The Con-Ops also addresses how the AME and its constituent processes are deployed for operational use within the Army. These same processes, enacted at the lowest operational levels, create new opportunities for efficiency. More importantly, the Con-Ops demonstrates how Army's automation efforts—enabled by AIT—can achieve important logistics management and mission effectiveness.

To better understand the focus of the Con-Ops it is necessary to introduce four terms. The hierarchical relationship of these terms, which have a fundamental significance within the Con-Ops, is shown in Figure 1-1.

Figure 1-1. Con-Ops Hierarchy

Automated Maintenance Environment (AME)

AME is the holistic environment that maintenance operations are conducted in or supported by. AME includes all facets of maintenance and logistics support, from the weapon system to the original equipment manufacturer (OEM). It also includes related functions and processes (e.g., supply, transportation, training, technical data). Although many functions within the AME are not directly visible to the maintainer, most are influential to overall logistical performance and the subsequent ability to complete a mission or sustain a given level of weapon system readiness. A fully functioning AME is the objective state achieved by the Con-Ops.

↓

Automated Information System (AIS)

AIS is the digital information system that supports data transfer and information management processes necessary to conduct Army logistics and missions. The AIS is emerging within the development of the Global Combat Support System–Army (GCSS-A) and the Wholesale Logistics Modernization Program (WLMP).

↓

Automated Maintenance System (AMS)

AMS is a subset of the AIS; the AMS is the digital information system designed to serve specific functions and processes for weapon system maintenance and maintenance management. The current form of AMS is the Unit-level Logistics System (ULLS) and the Standard Army Maintenance System (SAMS).

↓

Automatic Identification Technology (AIT)

AIT is a suite of technologies that enables the automatic capture of source data, thereby, enhancing the ability to identify, track, document, and control material, logistics processes, deploying forces, equipment, personnel, and cargo within the AMS and AIS.

BACKGROUND

This concept document "connects the dots" across all management levels and functional areas, creating a clear picture of how maintenance AIT functions within an overall Army AIS. In addition, the Con-Ops describes how AIT, when properly positioned in maintenance, enables the successful AME to facilitate weapon system improvement efforts (such as recapitalization and the National Maintenance Program) as well as enhanced life-cycle management programs.

The AME begins with the capability to uniquely identify desired items—reparables and other critical components (mission essential or flight safety)—throughout the stages of their life cycle and associated logistical processes. Identification of specific items promotes visibility and understanding of the operational or logistical conditions to which a single part or component is subjected. This gives the item or weapon system manager a never-before-seen view into the true cause and effect of all support issues that surround weapon system sustainment. The Army envisions its maintenance AIT will ensure data claimants have immediate access to essential information about selected products. Information will

span the entire product life cycle, from initial manufacturing through reutilization or destruction. The Army's AIT vision states:

> In a fully integrated AIS/AIT environment, Army maintainers create and use accurate, timely information about their activities and the products they maintain. The latest information is available on demand—and is updated easily by the maintainer in an automated environment. The information provides the maintainer specific product repair and performance histories, links to appropriate technical data and troubleshooting guides, and tracks comprehensive configuration information. Other Army material managers have access to the information to support their management activities.[1]

This Con-Ops is modeled on an Army aviation weapon system, the CH-47 helicopter and its support structure. However, this Con-Ops is not exclusive to either aviation or the CH-47. The CH-47 was selected as the model because the program management office of the CH-47 applies advanced maintenance concepts that use AIT (highlighted by their efforts with the Aviation Direct Parts Marking Program). The CH-47 also presented the opportunity to consider a broader range of implementation issues through the emergence of the modernized CH-47F helicopter (it provides both a legacy and a modernized weapons platform). Using the CH-47 as the model, we form a tangible foundation from which to demonstrate the challenges of establishing an AIT-enabled AME.

Interestingly, more complex issues were resident in the transition process of moving from the paper-based legacy system to the AME. Unfortunately, there is no "big-bang" event or other single occurrence that allows a full and immediate implementation of the AIS or its AIT enabler. The ability to proceed from a clean slate to the AME is not a viable option for the Army. The Army cannot pause combat readiness while the current logistics system is purged and another developed and put in place. As such, much of this Con-Ops discusses the transitional phase and the fundamental issues that must be understood and addressed.

Critical process and resource issues were continually readdressed at each implementation juncture within the Con-Ops. Attention was given to ensure solutions did not add to the burden of the maintainers or operational units. For example, we considered

- legacy versus modernized weapon system requirements;
- paper versus electronic media;
- identifying policy constraints on the emerging automated processes;
- dual supporting infrastructures;

[1] U.S. Army Deputy Chief of Staff for Logistics, "Maintenance Automatic Identification Technology: The Vision," December 2000.

- corrupt initial data; and
- connectivity issues.

In the end, the warfighter as well as the logistician must see a significant, measurable benefit in the use of the logistics information. More importantly, any advantage realized by the logistician place an additional fiscal burden on the operational unit and its maintainers. As an initial step in developing the AME, attention is first given to use of AIT at the weapon system. The proper implementation of AIT poses great potential for near-term benefit to the maintainer—in the form of a reduced administrative process, which requires a significant manhour investment.

However, by itself, the application of AIT does not yield a benefit. Initially, the process and application of AIT are large burdens for weapon system managers and maintainers. This remains so until the identifying data delivered by the AIT are used in a process that provides a commensurate benefit. The Con-Ops addresses this concern and demonstrates the timely benefits, albeit limited, delivered by the initial operating capability of the AIT and AMS combination.

The overall goal remains, however, the provision of equitable value across the logistics spectrum. Therefore, assigning AME imperatives for both the warfighter and logistician is essential. For the warfighter the AME imperative will be as follows:

- Reduce manual task entries (input and output) of the automated system.
- Reduce the overall maintenance manhours expended.
- Provide a precise assessment of an operational unit's go-to-war capability (GTWC).[2]
- Support the sustainment of a higher level of readiness through the use of precise and accurate logistical support (i.e., the ability to request the right part, for the right system, at the right time, at the right place, and with the right personnel).

For the sustainment community, (e.g., weapon system managers and logisticians) the imperatives of an AIT-enabled AME are as follows:

- Provide an accurate assessment of GTWC by an individual unit or as a collective force.
- Provide total weapon system support and component life-cycle management.
- Reduce operational and support costs in weapon system support.

[2] The GTWC assessment is explained in detail in Chapter 2. It is fundamental to the Con-Ops and provides the ultimate value to the warfighter.

- Develop and support anticipatory logistics processes.
- Increase weapon-system and unit-level readiness (i.e., the ability to obtain and sustain a higher level of readiness by delivering the right part, for the right system, at the right time, at the right place, and with the right personnel).

A number of AME features grant operational commanders and sustainment managers the accurate information they need to plan and even anticipate support issues. The AME envisioned in this Con-Ops includes the integration of AIT into a task-based maintenance management paradigm that better facilitates accurate information flow to and from all functional processes. The supporting AMS, which captures its raw data through machine-readable code, provides the ability to acquire more accurate information seamlessly. The AIS is structured to turn these data into information that facilitates a new concept for the measurement of mission potential.

PURPOSE OF DOCUMENT

Research for this document focused on the technical, operational, and cultural issues of implementing AIT in the AME in order to understand the impact on existing business processes and policies. This document provides an operational concept, illustrated by operational scenarios that address multiple maintenance levels (organizational through depot). It considers integration requirements with other functional areas. It also addresses changes to Army policy that would facilitate the AME.

A Communication Tool

Foremost, this Con-Ops serves as a medium for communicating an innovative and practical approach to weapon system management, which is applicable to both aviation and ground-based weapon systems and is enabled by AIT. The Army goals regarding maintenance AIT are outlined in the Army Deputy Chief of Staff, Logistics vision document, *Maintenance Automatic Identification Technology: The Vision*. This Con-Ops simply moves that vision to fruition by communicating a tangible model. The Con-Ops further facilitates the vision by characterizing the potential value to the warfighter once the AME is fully operational.

An Implementation Guide

This Con-Ops also serves as a guide for anyone charged with the implementation of AIT for an Army weapon system, or for those involved with the development of the AME. This document takes an enterprise perspective to AIT to answer the full range of weapon system management needs (from purchasing new components, to performing maintenance, to recording usage, to finally retiring components from the Army inventory). Even though it is modeled on the CH-47, the

concepts presented in this document are broadly applicable to all Army maintenance operations.

A Catalyst for Action

Finally, using operational scenarios, technical discussion, and business analysis, the document can serve as a catalyst for consensus on the optimal approach to the development, support, and use of AIT within an AME and its subsequent integration into all Army automated logistics.

DOCUMENT SCOPE

The Con-Ops provides a defined concept of how AIT is integral to Army information management goals and how an AIT-enabled AME is implemented, operated, and sustained. The magnitude and scope of implementing an AIT-enabled AMS necessitates dividing the process into phases. Therefore, the Con-Ops defines the application of AIT via three progressive phases—inception, transition, and objective—and provides a tangible example at each, using the CH-47 weapon system as a model.

Each phase characterizes the operational environment relative to the degree of AIT and AIS implementation. In addition, each phase is characterized by the effect of the system on the unit's overall GTWC—focusing on the operational unit, where the greatest responsibility for individual weapon system readiness resides.

Inception Phase

The inception phase provides a descriptive view of the preliminary AIT application to the existing maintenance environment and logistics information systems—both automated and manual. The phase describes AIT functionality and requirements (informational and support), and the role of the supporting infrastructure. In other words, the inception phase outlines the "how-to" strategy to successfully start implementation of an AIT-enabled AMS.

Transition Phase

The transition phase characterizes the initial operating capability of an AIT-enabled maintenance environment and describes the changes required to operate while in a dichotomous and transitional automated weapon system management environment. This includes the gradual elimination of legacy systems and simultaneous increase of the new AMS use and productivity. This phase addresses when and how to terminate support of legacy systems and when to energize new processes, as well as training and personnel issues.

Objective Phase

The objective phase describes the fully implemented and operational AME and discusses the benefits derived from applying business process reengineering and improvements. Sustainment requirements and processes for both AIT and its respective AMS are defined in this phase, as are the policy changes necessary to enable or optimize operations within the AME. In addition, system interfaces and integration requirements are introduced during the objective phase.

CONCEPT OVERVIEW

The purpose of a military logistic system is to support the warfighter and allow the marshalling of forces to effectively bringing the greatest power to bear on the enemy. Classically, this ability is seen through the eyes of the supply and transport functional specialists preparing for deployment, which is then switched to the supply and maintenance functional specialists during a conflict. Yet these views are inherently exclusive and only provide a narrow field of view for both logistician and warfighter. Consequently, the complete view, along with the subsequent understanding of true mission capability bases itself on "available" versus "required" resources. This is largely left to the logisticians' interpretation of warfighter requirements, as viewed from their functional perspectives.

There is, however, another capability emerging that brings together many aspects of logistics that provides the warfighter a forward-looking perspective. This capability accurately provides a measure of both current and future support (as it manifests itself in the total performance and not only a limited functional perspective) of a given unit with a given level of resources. This is done through a manifold of information-based technologies that are integrated into Army logistic practices. This focus on warfighting requirements is termed the GTWC assessment. Such an assessment of actual capabilities is needed under today's rules and mission needs and is the ultimate AME benefit to the warfighter.

The transition of manual aviation maintenance processes to an AME requires the coordinated transition of a number of independent, but interrelated, dimensions. To effectively manage this transition it is essential to understand the interactive dynamic of these dimensions and the sequence and primacy that is inherent in their evolution. To assist in describing this concept, we employ a particular technique, called a state-web diagram, throughout the Con-Ops.

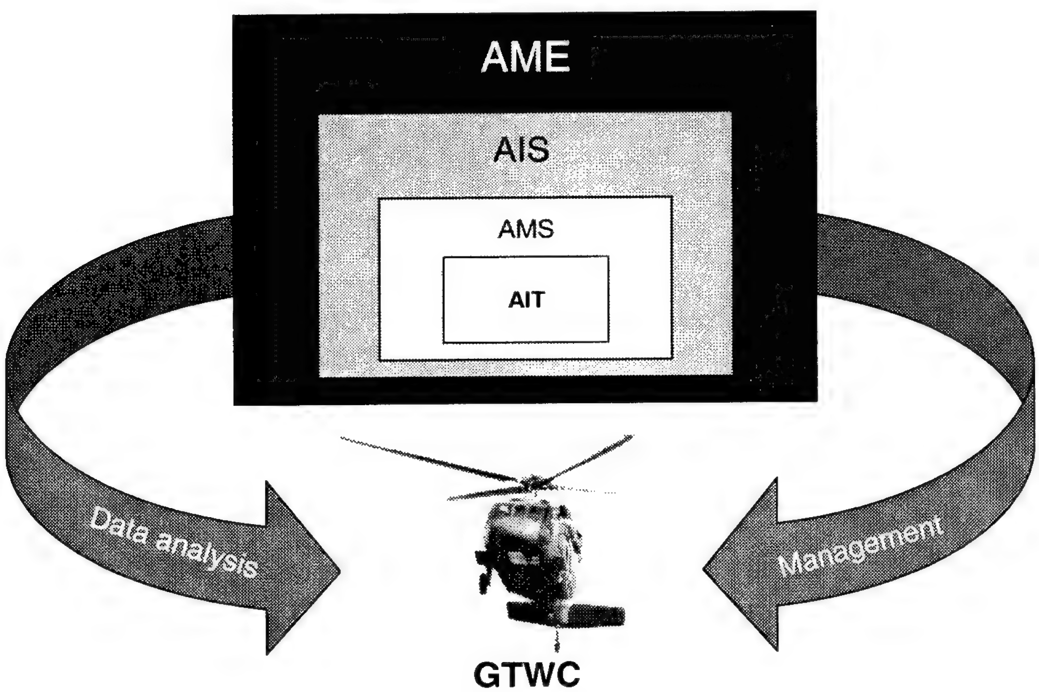
The benefits of AIT are directly proportional to the functionality within the overall AIS. Of course, maintenance is but one functional area of the Army logistics system. Therefore, this Con-Ops tries to illustrate the interrelationship between functional areas and to give a general description of how the data flow within that relationship. This is done for two reasons: first, to complete the operational picture; and second, to describe the AME's concept of holistic, cross-functional data movement. The Con-Ops delineates not only the specific issues related to the

architecture necessary to achieve what is possible today, but also describes a suitable architecture that is mobile, redundant, and fully operational in any variety of environments.

SYSTEM OVERVIEW

Figure 1-2 is a graphic representation of the terminology introduced in an earlier section. It demonstrates the relationship and position of the respective components of the AME.[3] The AME is broken into its composite parts to illustrate that AIT is integral to the AMS, which is a component of the AIS. All of these contribute to the holistic AME, which in turn enables the accurate assessment of the GTWC for the operational commander.

Figure 1-2. Overview of AME Component Relationships

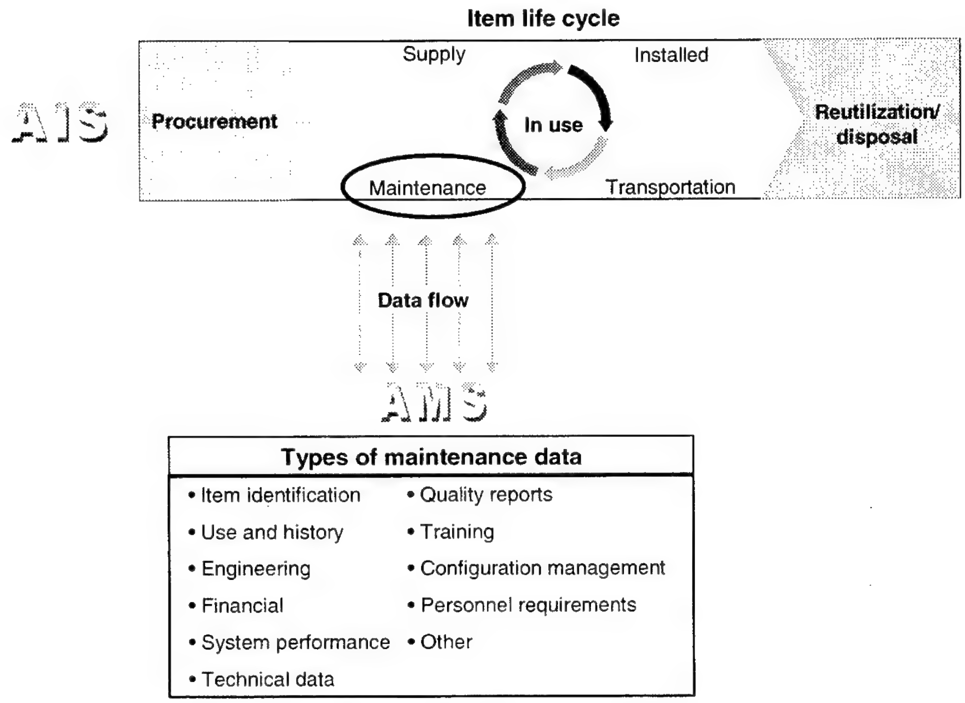


The data acquisition and information flow into and out of the AME from other functional processes are essential for an accurate GTWC assessment. Numerous inputs from other functional areas must be considered to accurately assess the GTWC for a commander—or to effectively manage the life cycle of a system and its component. Figure 1-3 illustrates a general description of the data flow involving the AME, the AIS, and the AMS in relation to component life-cycle

[3] This section defines and illustrates the AME in general terms. Additional detail is provided in the subsequent technical sections of the Con-Ops. Therefore, only an introduction of the system's components and their functional relationship to the AME, as well as to the operational methods of how they are envisioned for the objective end state, is presented at this juncture.

management. This figure also shows that AIT is not a system unto itself, rather the enabler for data accuracy and automation within the AMS and AIS.

Figure 1-3. Typical Data Flow Within the AME



The AME centers on the enterprise aspects of weapon system life-cycle and maintenance management as well as the GTWC assessment provided to the operational commander. Logistic information processes are segmented only by their affiliation to the AMS or the AIS and their influence on or position in the overall AME. This provides greater understanding of information requirements for the effective placement of AIT in support of a total AIS.

Chapter 2

Methodology

This chapter discusses the method and manners in which the AME is developed for the purpose of the Con-Ops. In addition, this chapter discusses why the AME is needed in terms of enhanced combat sustainment capability and weapon system management. This enhanced capability is the result of a successfully implemented AME that incorporates anticipatory logistics with an accurate mission assessment capability. This fully functional AME uses unique item identification, automatically captured through the use of AIT, to facilitate the automated information processes and functions of the AMS and the AIS.

DATA AND INFORMATION OVERVIEW

In defining the concept of AIT within the AME, and to better understand the degree of AIT integration necessary within the AME, it is necessary to describe the relevant information flow to and from multiple functional areas, which support maintenance operations.

Not all the information is directly acquired through an AIT process. In some processes, the information flow may be initiated by data acquisition through a maintenance AIT process, while in other processes the data are acquired through other means (e.g., an automated diagnostics system, a specific weapon system data acquisition system, manual entry), or acquired through another AIS (perhaps the Defense Logistics Agency [DLA] or a depot system).

Whatever the source, as they arrive into the AME the data must maintain integrity and association to their unique items. Therefore, it is necessary to understand what types of information are flowing into and out of the AME and why they are addressed in the Con-Ops.

The information may include any of the following:

- Weapon system performance and status
- The environmental conditions the item or system is or will be subjected to
- Modifications or improvements applied to an item
- The "cradle-to-grave" weapon system and component configuration (e.g., parent-child relationships, current system configuration, critical component tracking, and usage history)

- Maintenance resources available to the unit (including individual soldier qualifications and skills)
- Supply and transit information
- Repair schedules and status
- Technical data.

It is also necessary to describe the attributes and purpose of unique item identification. Unique item identification is essentially a "license plate" attached to each component that identifies and associates an item to the system or process that has managing custody. This license plate is presented as either a human-readable or a machine-readable (i.e., AIT) code. A unique identifier cannot be duplicated and must remain with the item throughout its life cycle. These identification requirements keep the integrity of relevant data and information about the item associated only to that item.

Currently, DoD and industry have accepted the following unique elements for item identification:

- Part number
- Serial number
- Manufacturer's CAGE (commercial activity/government entity) code.

These numbers are currently assigned without the benefit of a complete internal or external recognition of all assigned numbers. This means there is duplication of unique item identifiers in today's environment. In industry, this occurs because large companies do not have the automation or information to control all number assignments for all products manufactured in sub-facilities. Additionally, there is no global means to compare numbers of all items procured and inducted into the DoD system. Consequently, care must be taken while transitioning to the AME that source data are not duplicated. After achieving the AME, the AIS can automatically reference itself to verify new item identifiers are not duplicated and remain truly unique.

GTWC Assessment

Today, there is only a way to address the problem of defining the abilities of our forces to answer specific mission needs. Looking at the demonstrated past performance, one must extrapolate the performance of future requirements by using a best-guess method. For example, today we can essentially normalize operations tempo (OPTEMPO) rates by looking at flight-hour or operating-time rates. These normalized rates supply the common answer to the question, "How would an increase in flying hours or operating time affect supply availability?"

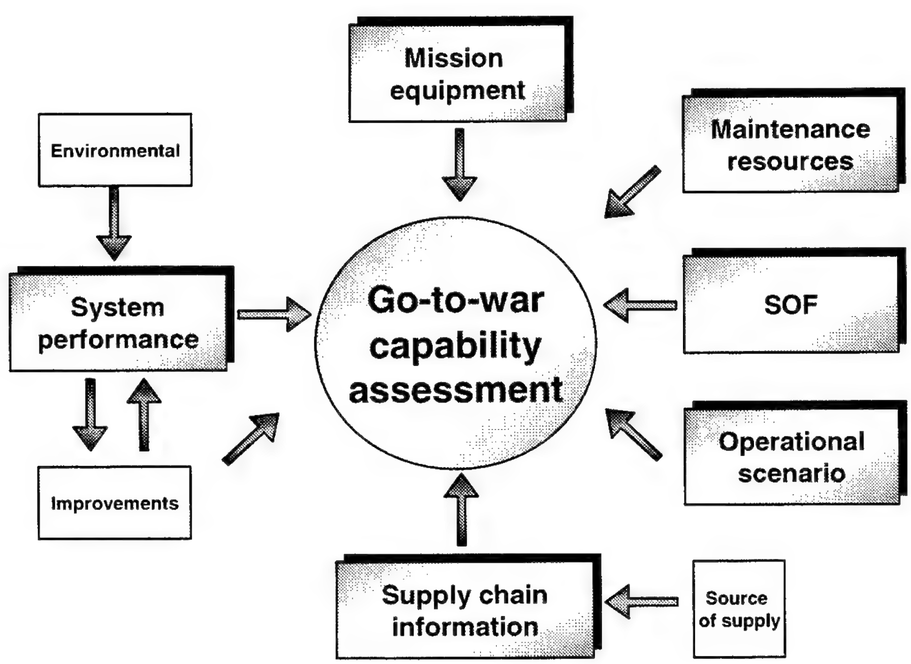
In this current method of assessment, it is routinely assumed that the soldier can rise to any task, given a responsive supply chain. This limits the Army to planning the next mission based only on past performance of similar weapon systems or situations. This past performance may no longer be valid or accurate. The true capability is undetermined due to the generalization of supply effectiveness over an averaged timeframe and the inability to understand true personnel capability. Thus, the only view the Army has for operational planning: rearward.

The AME presents to the operational commander and logistician a responsive and seamless logistics information flow that is based on the actual and most current flight-line or motor-pool performance and requirements. This shifts the perspective from the past to a view with a forward focus. By using the AME in this way, confident answers to what forces can or cannot do in the future compared to a specific requirement can be provided. This new forward focus is achieved through the AIT-enabled AME and is the prime benefit to the operational commander. This view is a planning tool known as the GTWC assessment.

For the GTWC assessment to answer the information needs of the commander, data from numerous separate sources are needed. These disparate data are then processed into easy-to-understand, support information that addresses the needs of the operational commanders in a positive sense.

There are a number of key elements in a successful assessment provided by the AME. Figure 2-1 identifies six of those elements that are directly applicable to the CH-47.

Figure 2-1. Information Needed in Assessing GTWC



Note: SOF = safety of flight.

Operational Scenario

The operational scenario information comprises the demands of the combat assets under the CH-47 operational commander's control. This can range all the way from supporting a training event in Alaska to simultaneously fighting a two-front conflict in both a jungle and desert environment.

This is the key point that starts the determination of the GTWC for any combat unit. The question, "Is the unit ready to go to war?" should be asked and answered in a timely fashion. The answer should either be

- "Yes, the unit can perform the mission as stated for X duration;" or
- "No, the mission cannot be performed," with a detailed explanation of why.

Mission Equipment

The current configuration and status of assets are the most critical pieces of information for any commander. This is not to be construed as the readiness information that is reported up the chain-of-command each month; rather as an accurate, near-real-time status of all combat assets within the commander's domain.

The key element is the configuration management of all the assets. A combat asset may not be truly mission-ready if it is measured only against a general category of readiness. The combat commander must know the full and exact status of each weapon system relative to the mission's needs. Without an understanding of the full capability of each of the combat assets, the commander cannot fully or readily answer the requirements of the operational scenario—unless he orders a timely inspection of each asset to make an individual assessment.

Maintenance Resources

A commander must have accurate data about his maintenance personnel resources and know of any impending losses due to routine transfers. This information is not just the counting of heads and military occupational skills (MOS) requirements; it also must include the levels of expertise. It is not sufficient for an MOS-critical mechanic to be counted as a fully ready asset if his current posting has reduced his proficiency because of an extended absence, training deficiency, or other extenuating circumstance.

Mechanics must have continuous training, and that training must be tracked so the commander may accurately assess maintenance resources. Additionally, the maintenance personnel and equipment resources available must extend beyond the unit's motor pool and flight line to include the intermediate- and direct-support assets included in the support of the operational scenario.

To complete the maintenance equation, depot capability that might accompany the unit through contracted services or other arrangements must also be tracked. It is equally critical to be able to rebuild a depot reparable component as it is to have the right MOS level at the flight line to install that component on the aircraft. These assets can become critical paths in long-term operational planning, and their visibility is necessary.

Weapon System Performance

Beyond current readiness reporting, there must be visibility of how systems are operating and what environment they may be subjected to. Some environments are harsher than others, but currently there is no visibility into the effect an environment has on individual weapon systems. It is critical that operating time be quantified according to its operational environment. Fleet managers and operational planners should have operational environment visibility to adjust for changes inflicted on supply demands or scheduled maintenance burdens. Also, from an operational standpoint, modifications installed in and on weapon systems must be evident to assess their influence on the overall combat capability.

Safety Messages

As with any aviation system, it is necessary to have full visibility of the status of all safety messages and requirements across the CH-47 fleet. Many aviation safety-of-flight (SOF) requirements are time limited and incur an operational restriction on the weapon systems. This information must be immediately available to the commander because an operational scenario may require the movement of assets to an environment where a SOF requirement can have an instantaneous impact. For ground weapon systems, the SOF is analogous to the maintenance information message or the technical bulletin.

Supply Chain Information

In the past, supply system information was considered the key to meeting any increase in OPTEMPO brought on by an operational requirement. Therefore, the logistician needs full visibility into the supply system to permit advanced planning. Visibility into the Class IX repair parts is desirable not only in terms of what is available but also what is the expected replenishment time for all projected requirements. It is insufficient to look only at percentages of fill across the demands generated for a weapon system. The commander needs to understand what each unsatisfied demand means to readiness.

In addition, the depot level must know what parts are available to facilitate the rebuilding of components. To obtain this information the depot considers the number of anticipated unserviceable reparables as well as prior knowledge of a reason for the failure of inbound unserviceable reparables. A critical backlog in depot reparables can significantly degrade a depot's repair cycle time and

jeopardize the operational mission. Consequently, the same forward focus on planning is required at the depot.

GTWC Assessment

As long as the above information is available to local commanders, operational planners, and logisticians, a useful assessment can be delivered for any operational scenario. This assessment addresses the requirements of the scenario and identifies any critical path or a short fall. The Army no longer needs to risk applying funds and assets to problems without full understanding of need or outcome.

The GTWC assessment gives Army leadership an innovative view into specific capability. In this Con-Ops, the AIT-enabled AME is not seen as an end in and of itself, but as the enabler for significant change within the military.

SYSTEM STATES

To further characterize the information flow it is necessary to define the up-and-down information required by the system at various phases of implementation. This also explains the automatic data acquisition capability present at each phase. Therefore, this Con-Ops uses a notional implementation schedule or program of an assumed AIS and AMS.

To illustrate the fact that introduction of the AME and its subcomponents takes place over time, we included scenarios into the varying states to illustrate a comparative level of activity present in each state. The states are described in the following paragraphs.

There are three phases in the migration to the AME. These phases represent the state of function and utility for AIT and the AIS; therefore, relative to this chapter, they are more aptly referred to as states. The state description corresponds to the phases introduced in Chapter 1 and can be considered as one and the same. Each state is defined by the maturity of the AMS, the AIS, and the AME, and the number and degree of integration of AIT portals implemented.

Inception State

The inception state reflects today's logistics processes. In the inception state the configuration and asset management and tracking, as well as several related processes that are required, are performed without AIT. Today these processes rely on the wisdom and actions of the logistician's culture to identify, track, and manage items using a forms-based process to perform the limited configuration and asset management functions within the maintenance environment.

Although automated to a small degree via the legacy Standard Army Management Information System (STAMIS), the input into the processes are manual.

Consequently, the current system only maintains one set of records that reflects the true configuration of the managed system. Furthermore, the current process for managing tracked items creates significant data latency issues.

The paper distribution of transactional data (e.g., the DA Form 2410 for aviation items)—plus the additional time latency before receipt at the point of manual entry into the current automated system—renders these data useful only at a gross-level of component and system tracking or management. As a result, we cannot use the enterprise-level data for specific and current aircraft configuration determination. This means every configuration-related directive or decision must be prefaced by a requirement to identify the configuration of the affected items worldwide. This is extremely burdensome and inefficient. In the inception state (i.e., current mode of operation), configuration visibility is possible only at the lowest system level and configuration issues are invisible to the enterprise.

Although the current processes and maintenance activities remain intact in the inception state, preliminary transition actions have taken place. Likewise, AIT and AMS pilot programs are completed with a full range of requirements understood and defined. In the inception state, the AIS is activated but limited in function and distribution; however, a fielding plan is established, enabling the issue of policy and organizational restructuring, with additional support being initiated as needed.

Transition State

During the transition to an AME, a temporary state of operation encompasses both the old maintenance system and the new AMS. While progressively implementing newer and more efficient functional capabilities and processes, the transition state is changing continuously.

This state is characterized by the introduction of the core AIS and the implementation of effective interfaces to the existing legacy STAMIS. It is equally distinguished by the progressive movement to a paperless AMS (elimination of DA forms required by DA Pam 738-751 and 738-750), with all of the paper-form functions subsumed by the AMS and an enterprise system for the transitioning organizations. The transition state enables a careful, complete, measured and efficient transition to the AME while mitigating risks that typify significant change.

At this point, the AIS starts to host additional users without any significant changes. The distribution of the overall configuration is broadened, with an increasing requirement for communication links between data collection points and data analysis centers. As necessary, the transitional architecture allows interfacing between AIT and non-AIT supported platforms. Manual data entry is possible where unavoidable, which is determined by the operational requirement to track and manage specified components. The intent is to introduce advanced data and maintenance process requirements on units only when they can deliver a commensurate benefit to that unit. The implementation burden of a new AMS/AIS

should be immediately offset to some degree by its benefit to the user, but consideration is given to the potential for corrupt initial data input, and uncontrolled manual entries into the new AMS are possible.

The fielding plan determines whether units run parallel systems (the AMS or ULLS/SAMS) for a given period, or if the entire unit transitions at once. Therefore, the fielding plan must consider such issues as

- the induction (into the unit) of a new weapon system design that can already function using the AMS/AIS (e.g., the CH-47F);
- the amount of supporting hardware and infrastructure required versus what is available; and
- the operational requirements that must be sustained.

Additionally, parallel operation of both systems must not degrade the existing manual systems. Proper transition to AIT begins only to enhance the component tracking function. In turn, this begins to provide the partial ability to assess the GTWC of the unit.

Objective State

The objective state is characterized by full and complete automation in data entry and maintenance processes. All organizations completely transition to and within the AME. The AME provides full process support for the configuration and asset management functions, and all other maintenance and sustainment processes. In this state, the configuration and asset management data for all units are visible at the enterprise level.

Interfaces to other systems or capabilities essential to the complete function of the AME are mature, seamless, and complete. All users are trained and supported by a continual-training package. Units are interconnected to data analysis centers, both on base and at deployed sites; however, the AMS can now sustain maintenance processes for limited periods without interconnectivity. Supply centers and platform operators are trained and equipped to mark parts opportunistically, assuming full integration of AIT into the AME.

Maintenance and weapon system managers now know where, and in what status, all select components are within the logistics chain or the individual weapon system. This enables the full GTWC assessment of the operational unit because the logistician can

- understand the actual maintenance requirements by individual system,

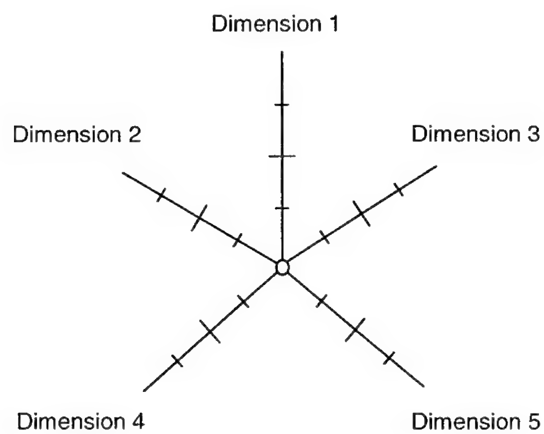
- develop component failure trends on installed components (based upon analysis of the actual operating data and conditions), and
- determine the accurate level of supplies required to sustain a specific unit, with a specific mission, operating in a specific environment.

THE STATE WEB

To better describe the intricate system state concept, a particular diagramming technique is employed: the state web. The name is derived from the way key points are circularly linked on a graph in order to depict an environment's current state through its association to the interrelating dimensions of that environment.

The diagram in Figure 2-2 is a state web. The framework of the web is made up of independent dimensions that have relevance to the particular environment being analyzed.

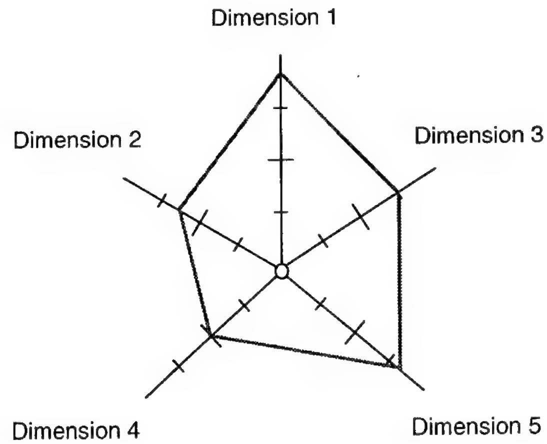
Figure 2-2. The State-Web Dimensions



This framework is overlaid with a continuous line that connects incremental points on each dimension to represent the appropriate level that must be achieved for a particular state. The resulting diagram becomes a "web," which not only shows the required levels to be attained in the individual dimensions, but the relationships among them that are necessary for the overall environment to achieve a target "state." Figure 2-3 illustrates this web.

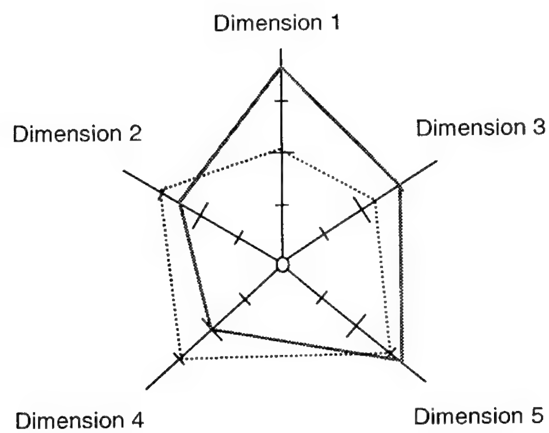
To achieve a desired state, the mapped overall environment must be completely enclosed and overlay the state web at the designated target points. These target points represent the incremental levels of each dimension; once connected they define the targeted state. If any part of the mapped environment lies within the boundary of the desired state web, then the target state is not yet achieved.

Figure 2-3. The Web Representing a Specific State



In Figure 2-4, the solid line represents the desired state to be achieved, and the dotted line represents the actual situation in the environment at a given point in time. The diagram shows that the environment has not yet reached the desired state because, while dimensions 2 and 4 have exceeded the minimum level required and dimension 5 has achieved the exact level required, dimensions 1 and 3 have not yet attained their required levels.

Figure 2-4. Desired State Web Compared to the Actual Web



Note: It is important to realize there are no metrics attached to the state web; it is a tool to illustrate conceptual development and progress.

The fact that certain dimensions exceed their requisite minimum levels does not compensate for any lagging dimensions. For the environment as a whole to attain a particular state, all dimensions must reach at least their minimum required levels for that state. Using the state-web technique to model the evolution of an environment makes it easy to visualize an otherwise complex set of relationships. It provides program planners a comprehensive view of the progressive relationship of dimensions within an environment.

Chapter 3
The Concept

This chapter discusses the general use of automatic identification technology relative to the specific goals of the Army and of the automated maintenance environment. It subsequently incorporates the use of AIT into a concept of operations based on the CH-47 weapon system.

AIT is an enabler for data accuracy within the AMS/AIS and is not a system unto itself. However, AIT is an integral part of the AMS and AIS, and is critical to how the AME develops and functions.

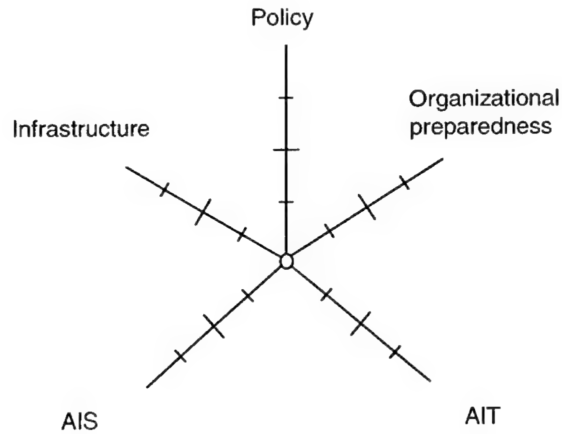
This Con-Ops is presented using the successful integration of AIT into a notional, advanced and fully automated information system. The effectiveness of this AIS is highly dependent upon the accuracy of the residing information, which in turn is dependent upon accurate initial data acquisition and post-acquisition data transfers. The availability and reliability of accurate data are critical to all processes used by the AIS. This chapter describes how AIT is introduced into an operational unit where it is systematically expanded, in conjunction with the AIS, to achieve the optimal objective end state.

Dimensions of the AME State Web

The evolution of a manual aviation maintenance process to an AME is predicated upon the coordinated transition of a number of independent, but interrelated dimensions. To effectively manage this transition, it is essential to identify and understand the interactive dynamics of these dimensions and the sequence and primacy that is inherent in their evolution. The use of the state-web modeling technique allows clearer understanding of these complex interrelationships.

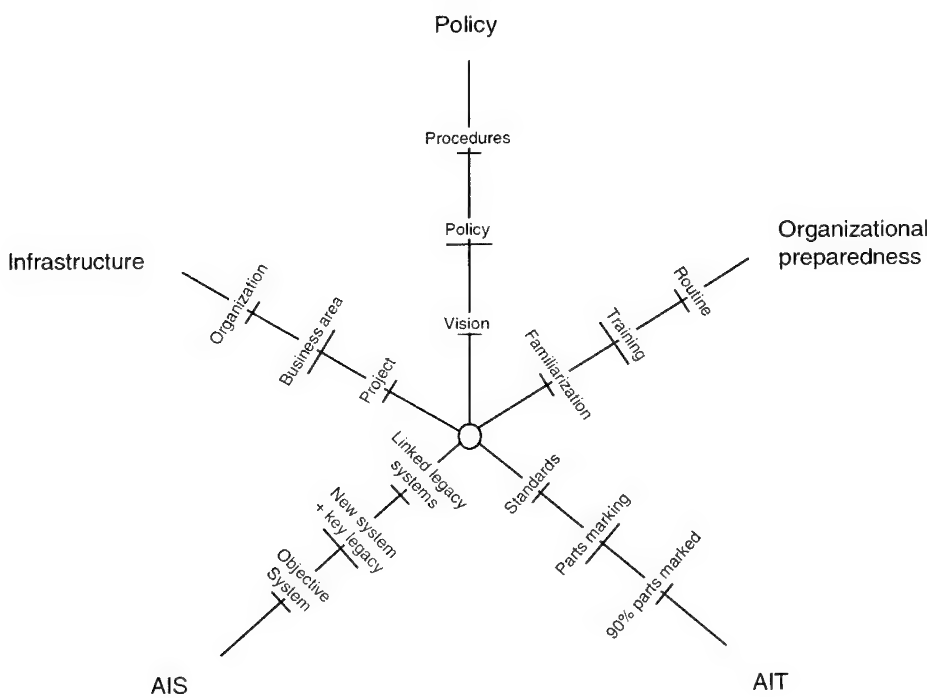
Figure 3-1 represents the five dimensions that are important in the transition to an AME: policy, infrastructure, organizational preparedness, the AIS, and AIT. Each dimension has its own dynamic and can evolve for reasons that are not associated with the transition to the AME. Changes need to be managed from a single functional perspective of the overall transition plan. The AME's state-web dimensions categorize the actions, activities, performance, or functions necessary to enable the intended goal of that dimension relative to its expectations within the AME. Each dimension of the AME web is described relative to its purpose and position to a particular state of the AME in the subsequent sections.

Figure 3-1. AME Web Dimensions



In order to migrate successfully from inception to the objective state, an incremental development path must be charted along each dimension. This path needs a series of achievable and recognizable milestones against which progress can be measured. This allows the comparison of progress between each dimension to assess overall progress and symmetry of the web development, bearing in mind that a non-symmetrical development may be a desired condition. Figure 3-2 shows some examples of events that may be considered suitable milestones.

Figure 3-2. AME Web Dimensions with Milestones



The salient aspects of each dimension to a successful AME are described in the following sections. While the sections characterize a general description of the

critical dimensions within the AME, they are not all encompassing. Much like the GTWC assessment elements, each dimension might take on different attributes that are relevant to the different weapon system to which they are applied.

The Policy Dimension

At its core, policy development has a shared vision across the enterprise. Together, this vision and policy form the cornerstone of an effective AIT program. Key to implementation is that the underlying policy supports the AIS and its related AIT enabler throughout the three states of inception, transition, and objective.

Policy issues cross many functional areas, including other state-web dimensions, and may venture outside the Army into the other services (or even into the private sector). Nevertheless, bringing all policy issues under a single dimension provides an essential focus. Therefore, the policy dimension acts as a container for all policy requirements across all the dimensions. The following is a sampling of these policy requirements:

- Standards
- Advanced policy revision process
- Engineering Practices
- Line of accountability
- Legal
- Safety
- Security
- Engineering
- Support
- Process and data capture
- Contractual.

These requirements are then categorized to fit a logical precedence that establishes the incremental movement and milestones of that dimension. For the policy dimension that means beginning with the vision milestone, moving to policy, and finishing with procedures (as illustrated in Figure 3-2).

To further characterize the incremental process within a dimension, and within its milestones, the following example is presented. "Policy milestone" is the second order of precedence under the "policy dimension" as it is generally considered to follow an articulated vision. Within the policy milestone, requirements are further categorized to fit a logical precedence. For example, development and implementation requirements for Army AIT standards would fall under the policy milestone. Therefore, it is added to the list of requirements necessary to complete the policy milestone and must be successfully achieved before moving to the next milestone: procedures.

This critical requirement for AIT standards is placed under the policy milestone and is appropriately named "standards." All subsets of requirements for the policy

milestone are further arranged according to precedence. Therefore, "standards" are assigned the first incremental precedence within the "policy milestone."

Standards are assigned first priority within the policy milestone because standards are the adhesive that binds what would otherwise be disparate, "stove-pipe" systems. Without common standards, the most that one could hope to achieve within the AME are varying levels of dissatisfaction for all users. This type of "dysfunctional accord" is eliminated through the application of policy that supports the best standards. Therefore, it is advantageous to place standards as the first priority within this milestone. In this sense, policy becomes the enabler—as well as a controller—for the AME's development, allowing an effective and efficient harmony within the targeted environment.

To further illustrate how the policy dimension is constructed and how it is incrementally prioritized, the relationship between current policy and future necessity to expeditiously and accurately change policy is now discussed.

Current Army policy is segmented by functions and is mostly constructed without a linking to a total business vision. Given the scope of a single AIS envisioned by the Army and the AME, both policies as well as the policy revision process must be modified. For example, currently, there is no Army automation doctrine. This circumvents the consolidation of issues and policies surrounding digital information systems. The collective representation of all automation is necessary to explain the degree of reliability and support the warfighter can rely on when conducting missions within the AME. This is also true for Army business and logistics managers. Policy revision needs to consider policy changes in relation to the total environment and not just in functional sections.

Because there is little desegregation of logistic functions to facilitate the optimization of process improvements and reengineering—obtainable through better information technologies and system management—one may conclude that policy needs to be realigned to better optimize the AME. Unfortunately, policy change processes present a Catch-22: policy pushes change, but change must first push policy.

Consequently, outdated policy constrains the rapid advancement of the AME. If changes in policy are incrementally too small or too slow in development and implementation they may stifle rapid change. A synergistic approach to policy change is needed to allow the rapid and full advancement of the AME. Therefore, revised methods to assess, address, and implement policy revision is the next increment of the policy dimension's policy milestone.

This advanced policy revision process is further represented by its own incremental steps and milestones, which require successful action before achieving the optimal effect of the AME. Possible sub-increments to the advanced policy revision process incremental requirement are as follows:

- Defining AIT policy in terms of overall objectives and goals
- Developing requirements for inclusion into high-level Army policy to implement and sustain AIT processes across functional areas for total logistical performance
- Developing an active policy group to assess the best working practices for the AME
- Defining organizational responsibilities and management functions necessary to transition to the objective AME
- Developing an acceptable and expeditious waiver program for deviations from current maintenance policy.

To successfully accomplish each of these sub-increments it might be necessary to complete all the requirements necessary to conclude that increment. The point being, each increment or milestone in any of the dimensions has its own level of granularity, which must be defined in regards to its relationship to that dimension, its milestones, and the other milestone increments. Movement to the next increment or milestone is based on the effective completion of its subset.

The Infrastructure Dimension

Infrastructure milestones are considered from the viewpoint of unit size and organizational role; whereas, initial infrastructure development is pursued at a project or program level. This progress is charted and used to move to business area (e.g., maintenance, supply and asset management) development. Infrastructure grows independently within each business area but it must be congruent with the requirements of an enterprise-wide implementation. The objective state infrastructure will result in an AME that is fully supported across all enterprise users.

The infrastructure dimension covers more than just the physical hardware and communication systems necessary for an information system. It encompasses a range of support activities that are essential not only to the operation of an AME, but to its sustainment as well, such as the

- communications backbone required to provide the needed bandwidth,
- provision and availability of required equipment,
- personnel,

- support policy (for both government-fielded equipment and contactor-fielded equipment), and

- publications.

The Organizational Preparedness Dimension

This dimension contains several intangibles that make it difficult to establish milestones against which progress can be measured. It is possible, however, to describe the key stages along this dimension:

- First, the affected organizations must be familiar with the concept of the AME. This familiarization is important to establish the buy-in from the maintenance community and prepare for the introduction of new equipment and procedures.

- After familiarizing users with the concept, it is then possible to move on to the training cycle. Training is easier to measure and control in terms of progress, but for it to be truly effective, it must map closely to the introduction and use of the new equipment and procedures.

- At the conclusion of the training cycle, maintainers can use effectively the equipment and procedures introduced within the AME.

The principal objective is to develop sustainable organizations in terms of structure, population, and culture that will enable the Army to maximize the benefits achieved from implementing an AME. The organizational-preparedness dimension addresses these elements conceptually rather than in terms of practical implementation; it is concerned with what to consider, not how to accomplish it. Organizational factors that enable the AME to function effectively and to maximize capability, include

- process identification,

- function identification,

- skills and staffing levels,

- development of training programs, and

- cultural change.

PROCESS IDENTIFICATION

Understanding the business process is a fundamental requirement before any system can be effectively changed or improved. Historically, organizations migrate toward doing things based upon longevity rather than a perceived or defined

requirement. Those nugatory or duplicate processes must be identified and eradicated before moving to the new system.

Rather than identify what the existing system does, it is more effective to define what the new system should do. This definition is based on process analysis and not historical data. With the introduction of AME, the migration from inception to the end state will involve iterative analysis of the business process at each stage.

Function Identification

Having identified the business processes, the organization's functional areas should be assigned, with the responsibility for those processes. Unambiguous functional requirements should be derived from each process, and ownership should be clearly established as part of the transition to the AME.

Skills and Staffing Levels

The organizational structure required for an AME will be different from a conventional (non-AME) maintenance organization. Again, detailed analysis will provide a more accurate starting point for the organizational needs in respect to skills and staffing levels, rather than attempting to "tweak" the existing structure. The AME Con-Ops provides a task-based maintenance paradigm as opposed to the existing error- or fault-based system. The maintenance emphasis will likely swing from unscheduled to scheduled events as the effectiveness of the AME becomes apparent. This will affect work patterns and skill-sets as the system evolves. A constant review cycle will offer more effective use of resources until the steady state is reached.

Development of Training Programs

The training start date is critical to the success of change. If too early, information is forgotten before it is ever utilized; too late, and maintainers and managers may be overwhelmed as soon as they start. A significant feature of the AME is its ability to record task type, duration and frequency, and the results of accomplishments against an individual. This provides an accurate record of what skills are needed, which are currently utilized, and which may be superfluous. At the same time, personnel records show which courses were already attended—bearing in mind a comprehensive training program to be developed based on actual needs and resources available to the individual or collective group.

Cultural Change

Cultural change is the single most critical contributing factor leading to the success or failure of any new program. The ability to fully understand and deal with the cultural aspects of change management is critical to the success of the AME. Therefore, the subject is discussed in greater length in the following paragraphs to

emphasize its importance. Additionally, the extra discussion is presented to reinforce the ability to effectively manage cultural change.

In the context of organizational preparedness, "culture" refers to aviation maintenance traditions, customs, and habits. The challenge is to manage the cultural changes required to move from the current system to an AME. Historically, as long as the organization's culture is stable, it continues on its set course with few major choices. Only occasionally does it reach a true crossroads.

The introduction of an AME forces action—and produces a number of possible pathways. The availability of new pathways and pressure to change environmental circumstances create the proverbial crossroads and the viable alternatives that branch from it.

The road traveled will depend on which has the best set of mutually supportive alternatives, which facilitates easy transitions from old patterns, and which is most in harmony with new circumstances. Therefore, if the AME is to become the chosen path, it must instinctively be the better option.

The lesson of the crossroads is simple: You cannot get off an old road and onto the new road without enduring an intermediate place. Individuals and groups transition at different rates and with different styles. Those at the center of the old culture and those who led the way during the old, stable phase will either

- embrace the new culture and contribute significantly to its creation, or
- remain so entrenched they are unable to keep pace and end up feeling alienated.

Eventually, the new alternative gains enough workability and support that it becomes the new framework—the new consensus. Those who thought the future would go in another direction may be bewildered, and either must adjust or fade. Up to this point, a lot of cultural development cannot happen. Now, tasks shift, enabling the new processes to grow and mature.

This cultural change requires careful planning, progress measurement, and total support from process owners. Change occurs in conjunction with AME implementation, but with a greater need for longer lead times and more preparation before each phase.

An executive sponsor from the owning organization is charged with managing the change. In programs where cultural change has been a key driver, participants

cited executive sponsor involvement as the single greatest contributor to success of their change management programs. Other success factors included

- participation in the change by all management levels in the organization;
- physical change—either an effective new tool or system (in this case, the AME) or movement to a new facility; and
- extreme pressure from outside the organization to change.

Mistakes are easy to make with a task of this magnitude. Delegation of sponsorship was cited as the number one mistake made by executive sponsors. Other common mistakes made during a major change are listed below:

- Not being directly involved with the project
- Not engaging all management levels in the change
- Sending inconsistent signals or not communicating enough
- Shifting focus or changing priorities too soon
- Not providing adequate resources.

The following actions had the greatest positive impact on the overall success of managing cultural change within an organization:

- Open and consistent communications
- Personnel changes in support of the new organization
- Support from all levels of management
- Training of employees before implementation.

Several other factors—sound organization, adaptation, cultural transformation, and established routines—bring about successful cultural change:

- *Organization.* Whoever first responds to a new vision must generally extend the communications to a broader audience and provide continuing support to those who have adopted the new vision. This is a group process, which requires sound organization.
- *Adaptation.* As the new vision receives broader exposure, it grows and changes. There are many potential reasons for these changes. The initial vision is usually incomplete, especially in practical details; certain accommodations may be made to broaden the appeal of the vision; and the original vision may include such things as predictions that fail to materialize, thus requiring re-explanation.

- *Cultural transformation*. If the movement can gain enough support, the thrust shifts from communication to implementation. If the "goal culture" cannot be immediately established, then a "transfer culture" is adopted as the route to get to the full vision. If this cultural shift is successful, the stress experienced by individuals declines dramatically.

- *Established routine*. Once the initial shift of cultural transformation has occurred, the next stage is to establish the new vision as the new steady state, which generally means institutionalizing it in various ways. Those in the forefront of the transformation process may find this last stage difficult and disappointing, but the bulk of the population is glad for a return to normalcy so that routine can be re-established.

In summary, the key to Army aviation achieving success will be significant buy-in from the maintenance community long before the introduction of an AME or implementation of AIT. Maintenance buy-in means the AME should be viewed as a positive shift in the maintenance paradigm.

AIS State-Web Dimension

Initially the AIS dimension is considered to be independently developed applications, each designed to satisfy the requirements of a group of business functions. As progress is made along the AIS dimension and the milestones are achieved, the independent applications are grouped and integrated to increase overall business effectiveness. New technology is introduced and linked to key legacy systems while other systems are eliminated. During the development of the AIS and at each milestone, the emphasis should remain on integrating the applications from the perspective of the total AME.

As the current stove-pipe applications are either integrated or removed, business processes that support new technology are introduced. Thus, the AIS progresses incrementally, from a series of isolated and disparate applications, to a fully connected AME.

The life-blood of the AME development is data. The ability to capture and utilize a full range of data is paramount at all stages of the AIS development, the premise of the AME being dependent upon data use. The AIS provides the reference set and controlling functions for those data. Early identification, capture, and population of source data are critical to effective AIS implementation.

Unique item identification is enabled through AIT devices. How the identifying data elements are established and how relative information is associated to those identifiers are distinct issues. This association of unique item identification to specific item data segregates the AIS into fundamentally different approaches to information management.

Both AIS approaches focus on the use of AIT as a medium for unique identification of an item. The first approach differs in that it keeps all essential information about that item with the component—via the AIT device. With the second information management approach, all other essential and relative information resides in a central database accessed via the AIS. This Con-Ops discusses these parallel approaches to information management and brings some resolution to the appropriateness of each in Chapter 4.

In addition, as a component of the AIS, the design of the AMS is critical to the effectiveness of the AME. The AMS is optimized through two key features: the new paradigm of task-based maintenance and the integration of technical data.

Task-Based Maintenance

Currently, Army maintenance follows fault-based maintenance procedures. This means all maintenance actions are associated to the originating fault. Faults are not standardized nor are they particularly accurate indicators of what has really happened to indicate a malfunction. A typical maintenance write-up may be, "engine caution light illuminated." The corrective action may follow with, "repaired engine light." It is difficult to form any substantial conclusions if you try to establish what the actual malfunction was, or what fixed it. With fault-based maintenance procedures, no relationship to the defective component is recorded. Was it the light or the engine that malfunctioned? Who or what actually fixed the problem?

Task-based maintenance is different. It automatically associates a fault to a specifically numbered task. Because all tasks are numbered and all work is assigned by task, all procedures performed against that task are automatically and invisibly tracked against the originating task number. For example, the same fault is listed as Task Number 303 (Engine caution light illuminated). Through the integrated technical data, a series of diagnostic and troubleshooting tasks are recommended, each with its own task number or subtask number.

As the mechanic proceeds, the information regarding what tasks are accomplished and what is consumed (repair parts and time) is automatically recorded. At completion, all tasks performed are associated to the attending mechanic, all parts or tools used or consumed are tallied, the time required to perform all actions is known. More importantly, the precise cause of the malfunction is known and associated with the offending component. The component and its replacement are accurately identified by their unique identifiers through the use of AIT.

Integrated Technical Data

This new task-based approach to maintenance is possible through integrated, interactive electronic technical data. The emphasis here is on the words "integrated" and "data," as opposed to interactive electronic technical manuals (IETMs). Technical data—everything from specific listings of weapon system configurations to

advisories on new maintenance procedures—are crucial when optimizing the AMS for the user as well as for the AME. The mechanics have no need to continually leave and reenter the automated maintenance program to refer to an IETM. Likewise, the technical data are automatically updated at the AMS whenever necessary; no mechanic intervention is required. The AME benefits are comprehensive as trend analysis is enabled for individual components, subsystems, or systems through the use of AIT and the associated performance data.

AIT State-Web Dimension

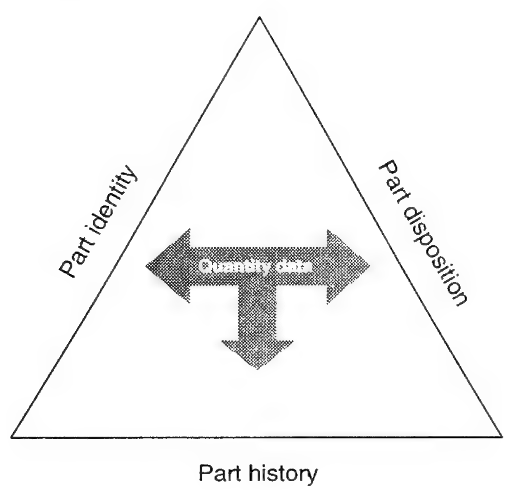
As with the other dimensions, development along the AIT dimension is only successful with adoption of a structured incremental approach with identifiable milestones. One of the first steps along the dimension is the identification of the standards and procedures to identify components consistently and repeatedly.

Having identified the AIT standards, policy must be implemented to control them. Actions are expanded to activate proper movement in the policy dimension. It is now possible to select the parts that receive AIT. Successful AIT implementation within the AME is characterized by the ability to manage unmarked parts by rules of exception.

AIT acts as the foundation for the Con-Ops strategy to capture and maintain high-quality digital support data on parts considered significant. Through AIT, the AIS obtains the quality data required to meet configuration and asset management requirements. This translates not only into an increased efficiency in the AME for weapon system sustainment, but into an enhancement of the predictive capability necessary to achieve the full GTWC assessment as well.

The key elements that provide high-quality data, delivered by AIT, necessary to support the goals of the AME are identified in Figure 3-3: part identity, part history, and part disposition (status and location).

Figure 3-3. Factors in Data Quality



Responsibility for the capture, communication, and management of these data are delegated to processes within the AME as a part migrates through the maintenance and support system. For these processes to deliver on their combined responsibility of consistent, high-quality data across the environment, they must be able to uniquely identify individual parts. In addition, each process must operate within standards in terms of part identification and data exchange.

The AIT dimension encompasses the specific processes and supporting technologies necessary for the production of these high-quality data. The issues to consider when addressing AIT fall into two distinct categories: business and technology.

The business issues relate to the part identity side of the triangle (Figure 3-3). They cover the identification of part types tracked, the standards and mechanisms that ensure their unique identification, and the manner in which the marking is carried out. Technology issues relate more to the other two sides of the triangle, part disposition and part history. Technology issues consider the mechanics of enabling parts history and disposition so that they are available as required by any process within the AME.

AIT is, at its core, the enabler to eliminate data error in the AIS. The accuracy in AIS data allows the sustainment base to perform effective weapon system management. In addition, it allows the AMS to seamlessly pass meaningful data through the AIS to the sustainment base. From that standpoint, AIT is first a read-only capability that provides the key to enter an enterprise database. This is exhibited in the front-line data source collection in the maintenance sectors of the aviation and auto industry. Following the precedent established in industry, the AME takes the same front-line data source collection and applies it to Army maintenance operations.

AIT States

The implementation of AIT and its associated information systems is discussed within the context of the three states of implementation (i.e., inception, transition, and objective). Each state is broken out by a scenario, a state summary, a table of activities, a state-web diagram, and a table of characteristics. This method is used to highlight the overall effects of AIT within the evolving AME that defines each state. It also describes the level of activity present in each state relative to maintainers' daily routine.

AIT in the Inception State

The inception state is marked by a clear vision that will take the current system to a new set of business processes marked by full integration of AIT capabilities. No new business processes are implemented during this phase. Instead, the programs

are put in place to move toward the new processes. Inception state characteristics include

- understanding of the high-level vision,
- definition pilot program,
- grant of necessary waivers,
- buy-in from all levels of the organization,
- identified target unit, and
- funding appropriated.

Inception State Scenario

Basically, the inception state scenario illustrates the processes and procedures as they exist today. Because the changes in this state are primarily programmatic—dealing largely with activating the enablers that allow the unit to begin implementation—there is marginal effect on existing processes and procedures. The following scenario centers on the routine scheduled maintenance requirement for a CH-47D helicopter. It is used for comparison purposes with the other states (i.e., transition and objective) of the AME.

The scenario focuses specifically on the sub-requirement of a required inspection and service called the "phase" inspection. The phase inspection is a comprehensive inspection and service of the entire aircraft that is necessary to certify the aircraft airworthy and safe. Phases are conducted in 800-flight-hour cycles with a different phase conducted every 200 flight hours (for a total of four separate phase inspections). At the end of the 800-hour schedule the cycle simply repeats itself.

Flight-Line Activity

The CH-47 Chinook maintenance team of the organizational aviation unit maintenance company (AVUM) inducts the CH-47D (tail number 647) into phase maintenance. The team has 40 days to complete its series of inspections and services and other maintenance to qualify the aircraft for another 200 hours of operation. The team cross-references a series of technical manuals, paper checklists, forms and records to identify the order and precedence for completing the work. In addition, the aircraft is inventoried by serial number for all flight-critical and time-life components.

The rotor head assembly is removed to facilitate access to individual parts that are reaching their life limit. Part identification information is written onto a "yellow tag," which is then attached to the rotor head. The mechanic notes on the tag for the respective part what the proper part number is believed to be, but often the mix of letter and numbers is confusing. A work order is initiated manually and

filed electronically at the unit's production control office, and then the entire rotor head is taken to the supporting aviation intermediate maintenance company (AVIM).

Intermediate Maintenance Activity

The AVIM prop and rotor shop receives the rotor head for inspection. During disassembly, mechanics inspect and tag each part to indicate serviceability. On this occasion, the mechanic finds excessive wear in the pitch bearing housing.

This discrepancy cannot be repaired by either the AVUM or AVIM, but it is replaceable. Therefore, the production control is notified that a replacement housing is necessary. After a confirmation inspection, the shop personnel complete a parts request form and submit it to technical supply. The part request data are entered into the ULLS-G system using the part information provided by the mechanic and an electronic requisition is submitted to the direct supply unit (DSU).

Within a few hours, the mechanic receives notification that a bearing housing is available at the DSU. Unfortunately, it is the correct part by national stock number (NSN) identification, but the wrong part by specific part number (the configuration of the rotor head was modified in the past but a proper "usable on code" did not detail this fact and it was not listed in the paper parts manual). Unbeknownst to the mechanic that ordered the part, there is only one part number that can be used with that configuration of rotor head. After picking up the part, the mechanic attempts to replace the housing.

While attempting to install the wrong part, the mechanic damages a critical surface of the rotor head, which now must be returned to a depot repair facility. The rotor head is reassembled and retagged as an unserviceable reparable. A component removal and installation record (DA Form 2410) is now completed on the rotor-head assembly, indicating its removal from aircraft 647. The aircraft's total flying hours are retrieved and entered on the 2410 form and the serviceability of the rotor head assembly is noted. The rotor head and all associated paperwork are accepted by the unit's technical supply. A turn-in document is created and the item is then passed to the DSU where the same turn-in procedures are again conducted before the item is eventually passed to the depot.

Depot Activity

The depot routinely overhauls CH-47 rotor heads using National Maintenance Work Requirements (NMWRs). This transportation process usually takes several months from the time the head is turned in at the DSU until it reaches the depot. Upon receipt of the rotor head, the depot compares the incoming paperwork with the AMCOM IMMC 2410[1] database to verify the information. The assembly is routed—via a shop traveler system and a tag system—to the first phase of its disassembly, inspection, and rebuild.

[1] Aviation and Missile Command Integrated Materiel Management Center database.

All parts need to be removed and thoroughly cleaned before overhaul. The paper tags are removed and placed in plastic bags (the tags will not survive many of the repair processes) that follow the parts as they make their way through the various repair processes.

COMMAND ACTIVITY

The command was first aware of the rotor head status when the requisition for the replacement rotor head was approved. It was not aware of any information concerning how much life remained on the assembly, how much was "used" by the unit, or how much life remains on the "reconditioned" hub that was received to replace it.

Although this information is now visible to the command through use of the AMS/AIS, the major issue is readiness and its effect on the combat availability of the CH-47 fleet. The emphasis is on getting the aircraft back into flight-ready condition by minimizing "not mission capable" time for both supply and maintenance through better visibility. Supply requisitions and maintenance work orders are tracked by status, which allows commanders to respond to associated issues as they occur.

SUSTAINMENT BASE ACTIVITY

After several weeks, the AMCOM IMMC receives the DA Form 2410 from the unit. The paper forms are routed for entry into the 2410 database. The analysis center at the OEM (Boeing) and other responsible component managers never see these transactions; nor do they have any understanding of what happens within a component's life cycle. In addition, the cause of the item's premature return (that is, before the expiration of its time life) to the depot was induced through human error. No training deficiencies are associated to the task or the individual.

SCENARIO SUMMARY

All the AME scenarios—inception, transition, and objective—are represented by four categories that capture the level of activity expressed in these scenarios. The intent is to quantify the activities—by the following categories—for comparison in the concept summary:

- Processes—All actions required to complete a major maintenance task or procedure.
- Manual data entry—Any entry requiring the transcription of information either through a keyboard or a pen/pencil entry.

- Maintenance actions—The individual tasks performed by maintenance and crew to complete a process.
- Supply actions—Each interface with the supply system as required to place an order, receive requisition status, and receive or turn in a part.

As shown in Table 3-1, there are at least 421 times during 32 processes when information on paper is entered or compared to electronic data (e.g., existing ULLS-A, SAMS, Standard Army Retail Supply System [SARSS], standard depot system [SDS], commodity command standard system [CCSS]). There are at least 877 maintenance actions that must be documented on paper or electronically. Likewise, there were 58 supply actions initiated to complete all processes that ultimately will return the rotor head to Army supply stocks. There is an additional need to document and report the aircraft's daily readiness status in relation to the ongoing maintenance and supply processes being conducted. Each transcription presents an opportunity for errors in either paperwork or data input.

Table 3-1. Inception State Process Activity

	Processes	Manual data entries	Maintenance actions	Supply actions
Inception state scenario				
Flight-line activity	5	120	550	50
Intermediate maintenance activity	5	57	77	4
Depot activity	15	120	250	4
Command activity	4	10		
Sustainment base activity	3	114		
Totals	32	421	877	58

Note: Not all parts are uniquely serialized so historical or usage information cannot be accurately tabulated.

Inception State Web

Figure 3-4 represents the inception state in terms of the state web. This reflects the levels of development required for each of the dimensions at the beginning of the program. As depicted by Figure 3-4, there is little movement regarding AIT or the AIS, as these aspects of the AME are not yet enabled. Sufficient policy has been established to start the advancement and expansion into the other dimensions. This is evident in both the infrastructure and organizational preparedness dimensions, which show positive movement as the organization prepares for implementation and the transition process.

Table 3-2 lists the characteristics of each of the five inception state dimensions.

Figure 3-4. Inception State Web

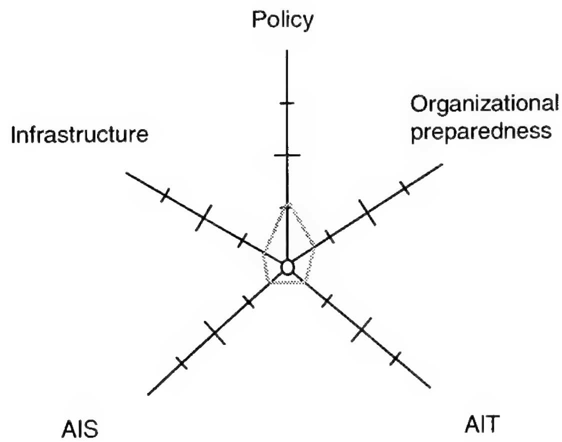


Table 3-2. Inception State Characteristics

Dimension	Characteristics
Policy	• A defined AIT policy in terms of parts marking standards to be adopted • Requirements included into high-level, guiding Army policy to implement and sustain AIT processes across functional areas for total logistical performance • Active development of policy and working practices for the AME • Organizational responsibilities and management functions • Waivers for deviations from current maintenance policy for pilot programs • Selection criteria for components marked • Funding procedures and paths • System performance measures • Integration and interface standards
Infrastructure	• Architecture defined and in compliance with overarching guidelines • Hardware selected and procured • Approved integration plan into the local information management office
Organizational preparedness	• Active development of organizational criteria established to develop the framework for the new organizations including, but not restricted to functional, educational, and training subgroups
AIS	Defined AIS strategy in terms of • evaluation of the requirements for the fielding of an AIS • development of procedures for the management of data in an automated environment • development of procedures for the berthing of aircraft into the AIS

Table 3-2. Inception State Characteristics (Continued)

Dimension	Characteristics
AIT	Defined parts marking strategy in terms of • classification of parts to be marked • identification of appropriate marks • establishment of approval process for applying marks • identification of mechanisms and methods to apply the marks • establishment of parts marking implementation program • no parts yet marked

AIT IN THE TRANSITION STATE

The transition state is marked by an increase in workload due to the fact the system must support two simultaneous business processes. The transition state is further characterized by the following:

- Aircraft are configured with varying combinations of marked and unmarked parts managed and maintained in an automated environment.
- Aircraft are configured with varying combinations of marked and unmarked parts managed and maintained in a manual environment.
- Aircraft are configured with varying combinations of marked and unmarked parts possibly migrating between automated and manual environments.
- Parts (marked or unmarked) will migrate between manual and automated maintenance environments.
- A partially functional AMS and AIS are in place at limited locations.
- Interactive electronic technical manuals are available to the unit.

These varying combinations are inevitable, especially in the early stages of transition. In order to provide the necessary flexibility for part migration, it is important that a part have only one identity, whether marked or unmarked. It is extremely restrictive and detrimental to operational availability to establish two distinct operating identities in terms of parts.

To ensure this single identity is utilized, the identifying elements on the part must be available to operators in all functional areas of the AME. This means the identification elements must be attached directly to the part, and they must be both machine- and human-readable. It is also essential to define the policy and supporting processes for managing the legacy data associated with a part that is assigned

new identifying elements. These two requirements must be satisfied in order to obtain the maximum benefits available from the use of AIT.

Transition State Scenario

FLIGHT-LINE ACTIVITY

As in the inception state scenario, the AVUM Chinook Maintenance Team inducts a CH-47D (tail number 647) into phase. This phase is being managed by a new automated maintenance management system. The team is given 35 days to complete this series of inspections and the scheduled and unscheduled maintenance to qualify the aircraft for another 200 hours of operation. Rather than using paper technical manuals, all maintenance is managed using integrated electronic technical data. The phase checklist is automatically cross-referenced to the tasks. Work orders for each inspection are generated and distributed to the mechanics, and the work is automatically laid out logically according to areas of the aircraft.

Mixed markings from CMBs to original data plates and labels are widespread. Parts that are AIT-marked are easy to inventory; those that are not, require the same pencil-and-paper reconciliation process with GCSS-A. This makes it difficult for the maintainer, but special processes were developed to manage it.

As in the inception state, the rotor head assembly must be removed to facilitate access to individual parts that are reaching their life limit. The mechanic uses a barcode scanner to load part identification information directly into the AMS. Some parts do not carry machine-readable marks yet, but the mechanics are trained to spot those that are targeted for AIT marking and apply the correct and accurate device before proceeding with the maintenance tasks.

As the parts are identified they are moved to the opportunistic marking station, which has been set up in a corner of the hangar. An extensively trained parts marking supervisor is responsible for physical application of the AIT. The supervisor trained to use the system ensures the part gets a correct supplier code, part number, and, more importantly, a unique serial number. Within 15 minutes the part is marked and returned to the mechanic and promptly scanned into the AMS.

After the inspection, the rotor head assembly must be passed to the AVIM for further maintenance. With a click of a button, the inspection results, all DA Form 2410 information, and the work order to the AVIM are printed out. The paper is placed into a plastic sleeve and attached to the rotor head. This provides the requisite information to transfer the part to the AVIM for repair.

INTERMEDIATE MAINTENANCE ACTIVITY

The prop and rotor shop receives the rotor head for repair. During disassembly, each part is scanned and inspected to determine its level of serviceability.

Following the situation presented in the inception state scenario, the mechanic finds excessive wear in the pitch bearing housing.

Because this cannot be repaired at AVUM or AVIM, production control is notified that a replacement housing is necessary. Following a confirmation inspection, a part request is generated in the AMS. Within a few minutes, there is notification that there are two available housings in the authorized stockage list (ASL). Although they are both the same NSN, the AMS system queries the mechanic as to the preference by part number. The mechanic quickly researches the issue and confirms which one is to be issued and used. The part is issued, immediately picked up, and delivered. Upon arrival, the mechanic scans the part into the AMS, replaces the housing, and reassembles the rotor head.

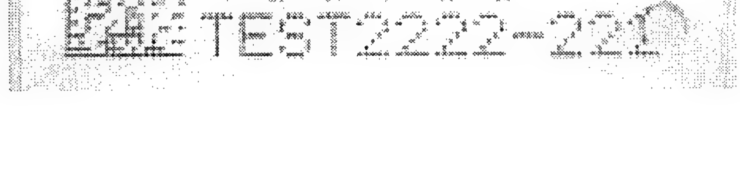
As the task is finished, the mechanic clicks on the "complete task" button in the AMS, and the information concerning the work accomplished and historical updates are printed and attached to the rotor head. The prop and rotor shop closes the work order and returns the rotor head to the AVUM.

Depot Activity

Rotor hubs—like those being used on AC 647—are overhauled regularly at the depot. The depot mechanics use electronic NMWRs delivered via the AIS to overhaul the assemblies. The depot always checks to correctly identify parts coming from the field. The depot is an important gateway in the fleet-wide marking process. A part cannot pass through the depot without receiving a unique AIT identifier. Moreover, without this marking, the part cannot be inducted into the depot maintenance system and workflow. Each part must be verified even if a DA Form 2410 is attached—mechanics might inadvertently transcribe the wrong number onto the forms if they are unable to scan the part. The unidentified part is checked against the AMCOM IMMC 2410 database and the new AIS database. After confirmation, the item is marked via AIT.

The depot doesn't induct a part into its system without first ensuring it has a supplier code, part number, and unique serial number attached directly to the part. Because the stripping process would remove any label, a supplemental metal tag that contains a data matrix code is attached to the part (see Figure 3-5). Paper tags are no longer used, and there is very little accompanying paperwork. The part has a unique identifier and is tracked by this identifier through the entire overhaul process.

Figure 3-5. Supplemental Identification Tag



As the part exits one process to enter another, it is scanned and logged either "in" or "out." That way, the AIS is aware of where the part is and its status. Upon completion of all work, the AIS database is already updated and can accurately indicate which configuration (e.g., the usable-on code) is applicable; however, the AIS still must update the AMCOM database. Consequently, paper 2410s are used as a back-up, but are submitted only as a formality.

Command Activity

The command has a new awareness of what is locally available and, for the first time, has an economic perspective on maintenance. The AIS provides the command elements with management information concerning the useful life of components installed on their aircraft. The AMS/AIS is starting to build the data necessary to predict the performance of these parts in the future. In addition, the command can receive the near-real-time aircraft status and can readily query the system for additional support information.

This readiness capability adds to the new concept of the GTWC assessment and will enable the command and fleet manager more comprehensive and accurate assessment of the unit's readiness. In time, insight through on-board and embedded diagnostic systems will reveal how the aircraft and its components are performing. In the transition state, accurate data start to be gathered on component and system usage rates, failure trends, and the relationship to environmental factors. The GTWC assessment has a limited ability to portray logistics requirements necessary to provide a mission capability. This assessment is based on flying-hour requirements and what supply and maintenance resources are available, rather than what is currently installed on the unit aircraft and its performance trends. Although still not complete, this is a very dynamic assessment that is forming through accurate data acquisition and the automation of information.

Sustainment Base Activity

The sustainment base is, for the first time, looking at data directly from the point of action. The acquisition of data is almost a real-time event as they are captured at each process and at each event. It provides a level of insight never before available. The item mangers know how many parts are currently in the supply chain, their condition, their applicability to their weapon systems, what usable life remains, and who has repaired them. There are still voids in total fleet information as the entire fleet is not yet transitioned, but the visibility of parts in the new AIS provides an awareness that was never before available. Recapitalized items are easily identified, monitored for proper performance, and managed accordingly. "Bad actor" components are identified and either corrected or eliminated.

Scenario Summary

As shown in Table 3-3, the transition creates reductions in data entry, supply, and maintenance actions, but shows an increase in processes. These increases

correspond to AIT implementation procedures (Because not all parts are marked, processes must now encompass the identification of parts to be marked as well as the actual marking of them.). No processes are eliminated at this juncture because not all parts can be marked at this time. If an item does not require disassembly to facilitate a maintenance task, whether or not it should be disassembled in order to facilitate marking with AIT is up to the discretion of the maintenance officer. The scenario exemplifies the marking process at the AVIM of the rotor head components; in reality, a complete disassembly may not have been required or desired.

Table 3-3. Transition State Process Activity

	Processes	Manual data entries	Maintenance actions	Supply actions
Transition state scenario				
Flight-line activity	6	10	480	25
Intermediate maintenance activity	5	0	55	1
Depot activity	17	30	250	
Command activity	5	0		
Sustainment base activity	5	0		
Totals	38	40	785	26

The maintainer and maintenance manager sees a reduction in supply and maintenance actions as the benefits of the AIS start to manifest themselves in reduced actions. At this point, there are still gaps in the information flow and the complete reliability of the AIS is not present; however, there is a significant avoidance of a number of events and tasks performed in the inception state scenario. The ability to identify and differentiate between the correct part and a wrong part eliminated the damage occurring to the rotor head as in the first scenario.

The depot role was represented but not directly used in this scenario—the rotor head sustained no damage, unlike the earlier scenario. Also, the transition of the AMCOM 2410 database into the AIS is in progress and nearing completion.

The largest benefit falls to the command role, however. The initial ability to manage the fleet based on available resources appears in the transition state. Future readiness is now linked to these resources, the specific configuration of the aircraft, and the environment that the unit will operate in. Life-cycle issues are becoming visible and trends are starting to be documented.

Recapitalized parts are all fully marked. The depot and opportunistic parts marking stations are in place and are making progress inducting parts in the system.

Transition State Web

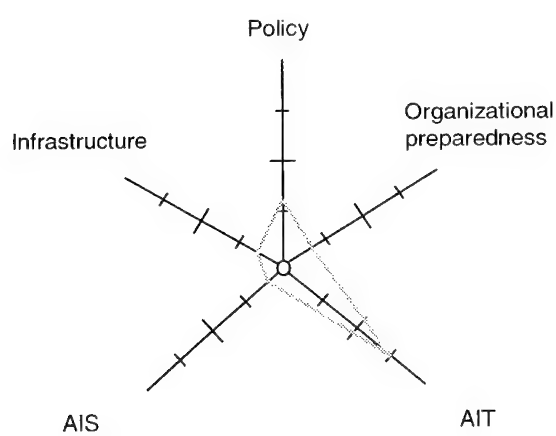
Between the inception and the objective states is the spectrum of transition. All dimensions are evolving towards their intended objective state values, but movement along a particular dimension may not achieve, in itself, any discernable benefit for the AME. However, enabling criteria are established for the continued development of the other dimensions, which eventually produce a benefit.

The importance of each dimension is well understood within that particular domain, but less clear are the interrelationships between the different dimensions of the state web. In many cases, development along a particular dimension will reach a threshold beyond which further progress is not effective until the enabling functions of an associated dimension are in place.

It is easy to over-develop one particular dimension of the new system (for reasons of funding, schedule, or resource for example) without gaining the anticipated benefits. This is particularly true if other dimensions of the state web have not been implemented to the degree required to enable certain functions.

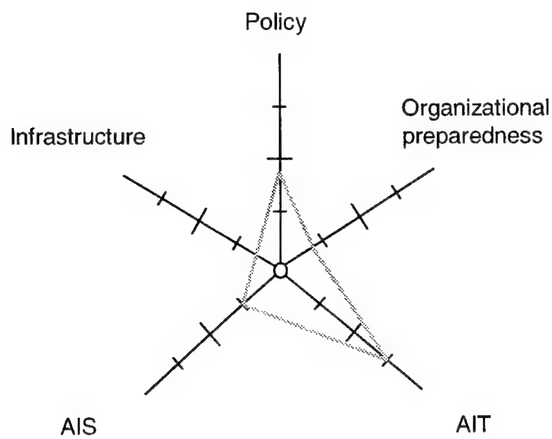
In Figure 3-6 a small increase in the policy dimension (in this case a new policy to allow accelerated introduction of AIT components) has resulted in a large development along the AIT dimension. Not only does this appear to be unbalanced on the diagram, but the reality is the maintainers now have access to a piece of AIT that does not help them. This is because there is no supporting AIS on which to host the data, the required organizational changes have not been implemented to ensure appropriate training on the new technology, and the infrastructure changes required to provide effective connectivity between users has not been introduced. In this situation, the premature introduction of AIT has not realized the anticipated cost benefits, but this may be a deliberate action that results from external drivers or programmatic choices.

Figure 3-6. AIT-Focused Development



In order to maximize the benefit of early introduction of AIT in the example above, it is essential to define and implement further policy, which then allows AIS introduction. An AIS permits AIT utilization. Figure 3-7 reveals that until now AIT has been purely an expenditure item with no obvious return on investment.

Figure 3-7. AIS Introduction



This situation applies across all the dimensions to varying degrees, but policy is the primary driver for changes in all other dimensions. The introduction of timely and appropriate policy is the bedrock for a balanced transition where cost benefits can be realized throughout the transition. Table 3-4 lists the characteristics of each of the five transition state dimensions.

Table 3-4. Transition State Characteristics

Dimension	Characteristics
Policy	Fully defined and implemented policy in terms of • organizational structures • parts marking strategy • AIS • interfacing to legacy STAMIS • training
Infrastructure	• Partially implemented communications backbone with required capacity and connectivity • All AIT and AIS support equipment (computers, monitors, scanners etc.) are fielded to activated units but are not yet fully supported as standard Army inventory or normal supply processes
Organizational preparedness	• Organizational structure reflects the change to new processes but is not yet fully manned • AIT and AIS training is provided as a separate maintainer training program • Technical and functional support organizations are not yet fully enabled

Table 3-4. Transition State Characteristics (Continued)

Dimension	Characteristics
AIS	• Partially fielded with limited functionality • Implemented interfaces to STAMIS • STAMIS is providing limited enhanced reporting and analysis
AIT	• A consistent marking standard is fully implemented • Varying percentages of tracked components are marked • Vendors begin marking all new tracked components • Limited implementation of process for marking non-marked components identified in the course of normal maintenance

AIT IN THE OBJECTIVE STATE

The AIT objective state is a new set of business processes that are fully enabled by an integrated AIT and AIS. The characteristics for a legacy weapon system are as follows:

- ◆ More than 90 percent of parts identified for tracking are marked and integrated into an appropriate AIS.
- ◆ All vendors are marking new parts in accordance with agreed standards.
- ◆ All new aircraft entering the AME have all parts marked in accordance with agreed standards.
- ◆ There is a process in place to manage the occurrence of an unmarked part within the AME.
- ◆ AIT is incorporated in all maintenance and support processes.
- ◆ A fully functional AMS and AIS are in place with fully-integrated, interactive technical data.

Objective State Scenario

FLIGHT-LINE ACTIVITY

Unlike the inception state and transition state scenarios, the AVUM Chinook maintenance team inducts a CH-47F (tail number 747) into phase. The F-model Chinook is fully modernized, and was delivered and maintained with a full suite of AIT and a fully functional AMS (which enables a paperless maintenance management system). The AMS and AIS are fully operational. All parts requiring AIT are marked, and an electronic configuration record is established and present in the AMS.

Before its arrival into phase, all required parts were automatically identified and provisioned via the AMS and its integrated technical data. The team usually turns a phase in 14 days to complete this series of inspections, and any detected unscheduled maintenance to qualify the aircraft for another 200 hours of operation. Electronic procedures, work orders, and work packages are already routed to the shops and to the AVIM. Now it is simply a matter of conducting the physical inspections, services, and maintenance. The work is automatically laid out in a logical order via task-based electronic maintenance cards (in other words, technical instructions downloaded on to handheld computer aids), which are based on the critical path areas automatically plotted for this aircraft.

As in the preceding scenarios, the rotor head assembly is removed to facilitate access to individual parts that are reaching their component life limits. However, advanced onboard diagnostics have captured health and usage data over the life of the components. The data indicate a high potential for life extension, as there has been no significant performance degradation or usage event that has accumulated a higher fatigue cycle count. Since the addition of advanced non-destructive testing techniques, most aircraft components are now "condition based" and are retired or overhauled based on how the aircraft is operated. However, part of the condition assessment is stipulated on availability of information enabled by AIT and the AMS/AIS. Engineering assessments are made from accurate individual-component usage data tracked through AIT and the AMS/AIS. Life extensions or reductions are then approved for individual components or component families based upon their predicted performance as determined by automated algorithmic processes and engineering analysis.

The mechanic logs onto the AMS using a personal code, which identifies the user to the system and associates all activity of that user to personnel data files. As assemblies are removed for inspection, the mechanic uses a barcode scanner to load part identification information directly from the AIT into the AMS. The AMS verifies configuration management through an interface with the AIS and integrated technical data. The AIS reports there is an engineering directive to thoroughly inspect a specific component—the red pitch housing—on 747's rotor head. Engineering authorities have closely monitored the housing in question because similar housings from the same manufacturer have undergone deficient machining, which caused premature wear. All pertinent technical data are automatically called forward and the mechanic is given all information in a task-by-task electronic format on the AMS. The mechanic downloads the information to a handheld device and starts the disassembly and inspection.

No significant problems were identified during the disassembly and inspection of the rotor head components, but a mechanic accidentally dropped a heavy rotor retention pin onto the concrete floor. With a quick scan of the part, and one push of the button back at the AMS station, the mechanic searches for the same part. In seconds, the AMS search returns information that there is a replacement pin in the authorized stockage list—and that it is correct for this configuration of rotor head and aircraft. Confirmation is given to supply via the AMS and the release and

issue order is automatically generated. The mechanic is then prompted for information regarding the circumstances of the damaged pin. He enters the information, which is electronically verified by the shop supervisor and passed electronically to the AIS component database for permanent inclusion to that component's history file.

Continuing the inspection, the mechanic finds no other deficiencies; however, an engineering decision is required for the red pitch housing. The information is sent electronically via the AMS directly to the proponent engineering office. The approval is returned the following day and posted in the AIS component database with the individual component data file, which provides a record for the remainder of this component's useful life. This direct connection to engineering, and the ability to uniquely identify an item and understand its history, has eliminated the need for any intermediate maintenance support. Through better information management, enabled by AIT, component life-cycle management has increased reliability, added a degree of prognostic capability, and allowed an effective two-level maintenance system to evolve.

Depot Activity

In the objective state, rotor heads are overhauled at the depot as needed. The mechanics use virtual NMWRs in much the same manner that the AMS is used on the flight line. All components arriving at the depot for repair or overhaul are anticipated and expected. The complete component history is associated to the unique item identifier represented by its AIT. Through AIT, the AMS, and the AIS the item is managed through its entire life cycle and its performance is assessed against its history, trend analysis of like components, and its operational environment. The depot accesses all of this information, and assigns a proper and specific maintenance regime.

In the case of the damaged rotor pin, the depot was alerted in advance as to when and why the item would arrive, and that it would need minor machining to return it to a serviceable status. Once the item is received, the deport system recognizes it through AIT and quickly assigns it to the correct induction and repair processes.

The depot performs all work related to the specific part using the item identifier, and the part is tracked by this identifier through the entire repair and overhaul process. As the part is exiting one process to enter another, it is scanned and logged out or in. The depot system is then aware of where the part is and its status within the depot system. Upon completion, the AIS database is updated and can accurately indicate what the component configuration is and what usable-on code is applicable. Accurate repair costs are visible, and procurement channels can be activated if the item is condemned. The property disposal channels and processes can be activated as well if required to properly dispose of an item. The item would then be removed from the active component database for transfer to an inactive file. If a question were ever to come up regarding this component (e.g., if it was

inadvertently returned to serviceable stocks) there would be a record of its associated data, which would identify it as a condemned item.

Command Activity

The command has complete awareness of its fleet status for any given period—past, present, and, with limitations, the future. The AIS provides the command complete information concerning the useful life of installed components on their aircraft, which can be compared to fleet-wide norms. An accurate assessment of a unit's GTWC is always available. In fact, the command can compare its present situation with any number of scenarios. More importantly, once alerted for deployment, the unit knows exactly what is needed to get the individual aircraft ready for any identified contingency. In addition, the unit now knows how long it can sustain itself within a given range of resources or environments.

The fleet manager and the operational unit are now a team, with comprehensive tools to determine precisely what is necessary to provide surge or sustainment capabilities. This information is based on flying-hour requirements that are balanced by what is installed on the unit's aircraft, how it is being operated, how it is going to be operated, and what is available locally. The unit no longer pays for a capability it does not necessarily need; rather, it pays only for what is needed as it is needed. The AME provides a dynamic capability enabled by accurate data in the AIS, and is flexible enough to provision the fleet for any contingency in near real time.

Sustainment Base Activity

The sustainment base has all the information necessary to manage components through their entire life cycle. Each selected component is uniquely identified and visible throughout all processes in all logistics functional areas. The pertinent data required for flight safety, financial tracking, performance monitoring, transportation, and asset accountability reside in a central database and are instantly and permanently associated to their unique identifier. Any managing office supporting the sustainment of a component family, weapon system, or operational unit can access these data for processing. Through the use of the central database and the AIS, there are no longer segmented and independent databases with unique systems and processes that only serve an independent interest or a specific aspect of sustainment.

The ability to properly assess personnel performance is enabled through the use of the AIS. All actions are associated to the log-on user's profile. Training, proficiency certification, assignments, and other performance factors can be accessed to understand the GTWC inherent in the personnel assigned to the unit. Collective or individual training is assigned to quickly mitigate negative maintenance trends. Institutional training is assessed based on the first-time performance of new tasks or new mechanics.

SCENARIO SUMMARY

The objective state is a cohesive and responsive network of capabilities and information. Fully integrated and interactive technical data reside in the AMS and enable seamless transition from maintenance management, maintenance task assignment, and supply actions. Everything in it ties back to each component as it is installed on individual platforms and weapon systems. It is a configuration-centric system that can, for the first time, accurately and completely predict potential mission success and sustaining requirements—based on the current condition of the aircraft, how aircraft are being operated, and mission requirements.

In this objective state scenario, there is a significant reduction in all maintenance activities, as illustrated in Table 3-5.

Table 3-5. Objective State Process Activity

	Processes	Manual data entries	Maintenance actions	Supply actions
Objective state scenario				
Flight-line activity	3	0	200	2
Depot activity	12	0	250	
Command activity	8	0		
Sustainment base activity	3	0		
Totals	26	0	450	2

Objective State Web

Figure 3-8 represents the objective state in terms of the state web. This reflects the base measures for each of the dimensions necessary at the end of the program. In this state, the milestones of the dimensions in Table 3-6 have been achieved.

Figure 3-8. Objective State Web

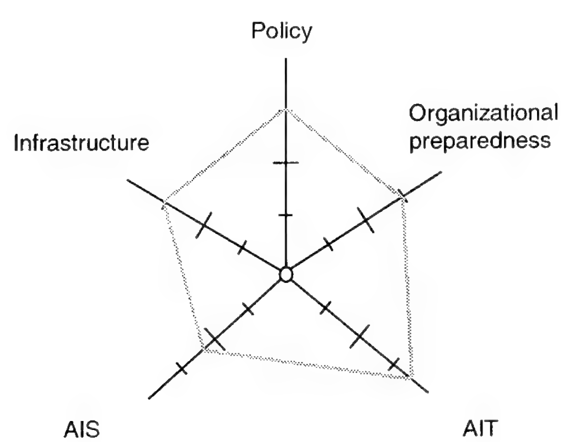


Table 3-6. Objective State Characteristics

Dimension	Characteristics
Policy	Fully defined and implemented policy in terms of • organizational structures • parts marking strategy • AIS • interfacing to legacy STAMIS • training • doctrinal roles and responsibilities
Infrastructure	• Fully implemented communications backbone with required capacity and connectivity • All AIT and AIS support equipment (computers, monitors, scanners etc.) part of the standard Army inventory and available via normal supply process
Organizational preparedness	• Organizational structure reflects the change to new processes • AIT and AIS training is an integral component of basic maintainer training program • Technical and functional support organization
AIS	• Fully fielded and functional • Implemented interfaces to STAMIS • STAMIS is providing enhanced reporting and analysis
AIT	• A consistent marking standard is fully implemented • Greater than 90 percent of tracked components are marked • Vendors are marking all new tracked components • Implemented process for marking non-marked components, identified in the course of normal maintenance

CONCEPT STRATEGY SUMMARY

Figure 3-9 shows a conceptual representation of the state web as it transitions to the AME's objective state. The key milestones along each dimension are indicative of the events likely to be captured by an AME implementation program. The achievement of interdependent milestones along each of the dimensions determines the success of AME development. These dependencies are driven by the functional requirements of the evolving system and are unlikely to be conveniently grouped around funding or programmatic boundaries. The ability to manage across these dimensional boundaries while maintaining a clear vision of the overall objective infers the need to have strong leadership and responsibility at a level that has ownership of the entire implementation of the AME.

Figure 3-9. Completed Objective State Web Showing Stages of Transition

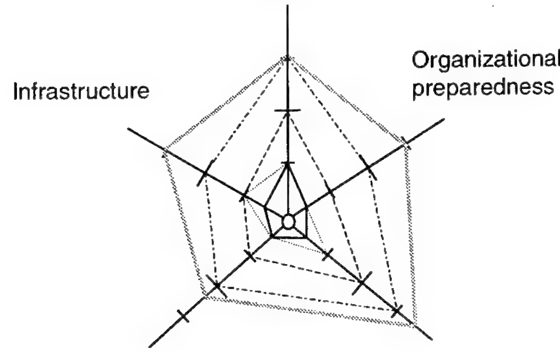


Table 3-7 is a compilation of activity listed in all of the preceding scenarios. The numbers are provided to indicate the level of effort and activity required to fulfill the sample maintenance action described. These numbers come from a top-level investigation that included the operational units, the OEM, and subject matter experts. The numbers are for comparison purposes only, and reflect a generalization of the overall activity present.

Table 3-7. Compilation of All State Process Activities

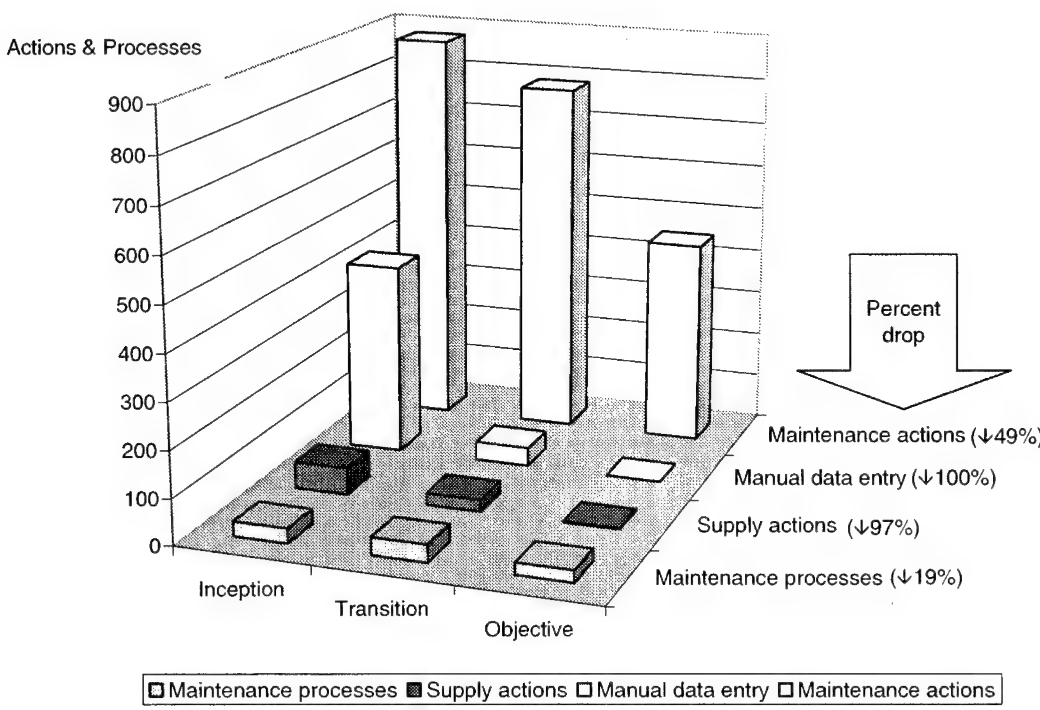
	Processes	Manual data entries	Maintenance actions	Supply actions
Inception state scenario				
Flight-line activity	5	120	550	50
Intermediate maintenance activity	5	57	77	4
Depot activity	15	120	250	4
Command activity	4	10		
Sustainment base activity	3	114		
Inception state totals	32	421	877	58
Transition state scenario				
Flight-line activity	6	10	480	25
Intermediate maintenance activity	5	0	55	1
Depot activity	17	30	250	
Command activity	5	0		
Sustainment base activity	5	0		
Transition state totals	38	40	785	26

Table 3-7. Compilation of All State Process Activities (Continued)

	Processes	Manual data entries	Maintenance actions	Supply actions
Objective state scenario				
Flight-line activity	3	0	200	2
Depot activity	12	0	250	
Command activity	8	0		
Sustainment base activity	3	0		
Objective state totals	26	0	450	2

In the example represented in the scenarios, and numerically represented in Figure 3-10, there is a 19 percent reduction of maintenance processes and a 49 percent reduction in associated maintenance actions from inception to the objective state. The reduction in supply actions is 97 percent and there is a complete elimination of manual data entries. Although this is just one example, the example cited is a very typical representation of maintenance processes and routine. If measured against manhours and averaged over the entire phase-maintenance process, we would see tremendous gains in manpower and productivity at the user level.

Figure 3-10. Reduction of Actions, Manual Data Entries, and Processes from Inception to Objective State



This decrease in maintenance requirements directly correlates to an increase in combat sustainment capability, which further correlates to a direct increase in

combat availability (in both personnel and weapon systems). If applied to an entire fleet of CH-47 aircraft or other weapon systems, the gains are exponentially expanded. This provides the Army an unprecedented advancement in the revolution in military logistics and assists in the Army transformation efforts.

The use of AIT in conjunction with the AMS and AIS provides a measurable reduction in sustainment requirements. However, as sustainment processes are reduced there is a corresponding and proportional increase of user dependency on the AIS and AMS. In the objective state, maintenance operations become completely dependent on the AMS/AIS processes and, in effect, this dependency is irreversible. At the objective state, reversing the use of AMS or AIS would create a huge gap in accurate data and grossly corrupt the core information system. More importantly, essential weapon system operating information no longer would be available—the effect of the loss being relative to the individual weapon system and mission design series.

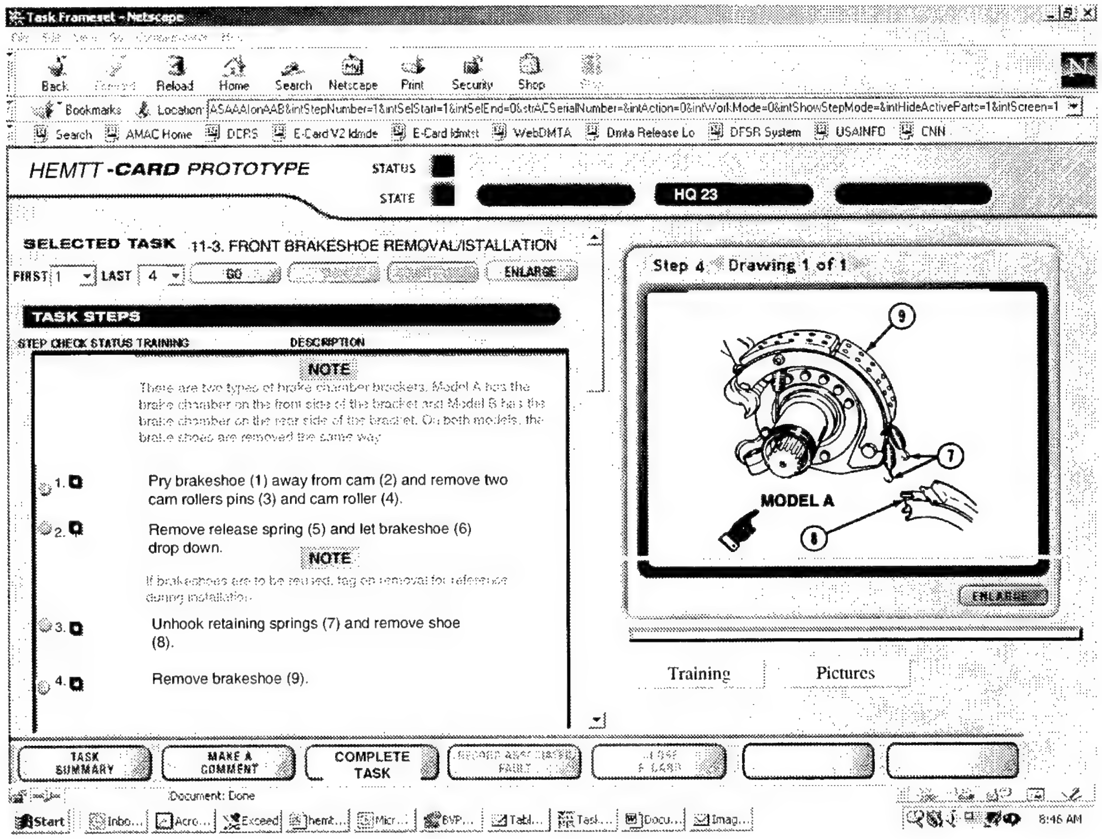
Therefore, in the objective state the AMS and the AIS system are considered critical to mission operations and must be functional at the weapon system for that system to be considered fully mission capable. Not having the AMS present and fully functional at the weapon system is analogous to not having the paper-based logbook and historical records in today's aviation environment.

The AMS is critical to the operational status of the weapon system for another reason as well—technical data. Technical data are currently thought of in the context of paper manuals. As the implementation of AME matures from the inception state through the transition state, interactive electronic technical manuals are introduced. However, having a stand-alone interactive technical data capability will not fulfill the goals of the AME.

Therefore, in the objective state, the technical data are fully integrated into the AMS as shown in Figure 3-11. This example is for the HEMTT (Heavy Expanded-Mobility Tactical Truck) wheeled vehicle and shows how technical data can be viewed for any weapon system. This provides the seamless transition from maintenance action, to supply action, to maintenance management. The users never have to leave one program and enter another to conclude a process or procedure. This degree of integration is essential to reducing maintenance and supply processes, and is essential in supporting a true task-based AMS. The fully integrated, interactive, electronic technical data are managed by a reference center, via the AIS, which is explained in detail in Chapter 5.

The move into the AME necessitates the AMS is always present and operational to complete the full mission capability of the weapon system. It is inevitable, however, that at some point there will be a temporary disconnection (intentional or unintentional) of the AMS from the AIS. In this situation, the user can automatically upload component information into the AMS, but the data cannot be verified or processed by the AIS and can potentially corrupt both systems.

Figure 3-11. Integrated Technical Data in the AMS



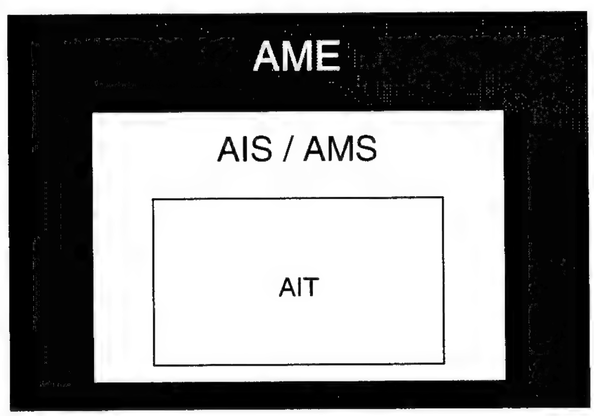
Disconnection of the AMS from the AIS is only a temporary condition and continued operations can be sustained at a local level through the AMS. Once reconnected, however, there is the potential for the AMS to flood the AIS with corrupt data—possibly data that were not properly validated during the disconnected period. Therefore, while one of the key identified benefits realized in the objective state is the elimination of any need for manual data input, this is not the whole picture. There is still the requirement for manual input. For example, one of the design aspects for avoiding single-point failure is the ability to capture component information manually. This imposes a requirement on the AIT standard to support manual data entry.

That requirement limits the applicability of some AIT methods, because human-readable data must reside on the component along with the machine-readable AIT. Because human-readable data coexist with barcode and data matrix symbology methods and are currently present on most component data plates, a least-cost opportunity for manual entry is available. In addition, the option requires no additional training and is easily understood by the mechanics.

Chapter 4
Technical Description

This chapter describes, in more technical detail, how the hierarchical components of the AME function alone and as part of an integrated system to provide the fully capable automated maintenance environment. Figure 4-1 is a representation of the relationships between significant AME components. The internal components consist of AIT, the AMS, and the AIS. For the sake of simplicity, any further discussion incorporates AMS in the overarching representation of the AIS. In addition, while there are external components—data and management—they are not represented in the diagram. They do, however, emerge at various junctures within the chapter. The diagram in Figure 4-1 is repeated in the introductions for each of the following sections that deal with these components in more detail.

Figure 4-1. Components Within the AME



The three internal components of the system are described within this section to define the technical aspects of the Con-Ops. Although these components are defined in the preceding chapters, it is advantageous to reconsider them from a technical perspective.

- *Automated maintenance environment* is the combination of all Army maintenance's business, logistics, and operational processes with automated technology and digital systems to provide a total information environment to serve all aspects of operations and weapon system support.

- *Automated information system* is referred to, for the sake of simplicity in this chapter, in its integrated status as the AIS/AMS. This hopefully instills an understanding of the synergy between two independent systems that work as a fully integrated system but, on occasion, must operate separately. At times, however, it is still necessary to refer to the specific

function of either the AMS or the AIS when discussing the technical design of the AME.

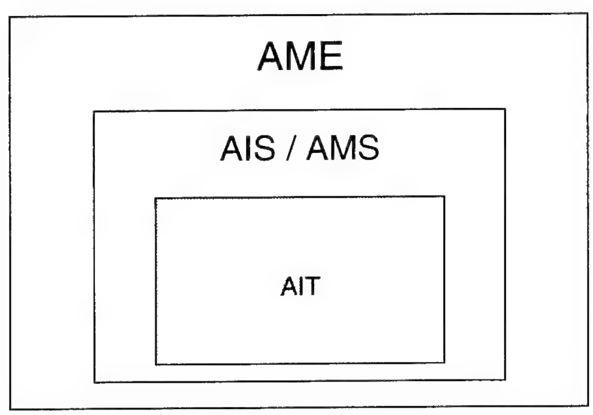
- *Automatic identification technology* include the devices and accompanying methods that enable the automatic capture of source data.

Full definitions of the components of the AME were offered in Chapter 1. The Con-Ops uses the CH-47 weapon system as the model to provide the reader with a view of how the technical issues of the AME are addressed.

The principle behind AIT is to act as an enabler in the acquisition of data used in computer-based processing. To be able to effectively deliver on this principle in the context of the AIS and AME (see Figure 4-2), a number of objectives must be achieved:

- Standardization of unique identification of parts
- Designation of criteria for the selection of candidate part types for tracking
- Identification and selection of appropriate AIT
- Determination of a strategy for marking parts.

Figure 4-2. AIT Within the AME



Unique Identification Standards

As introduced in Chapter 2, three prime attributes normally support unique part identification. These are the CAGE code, part number, and serial number. Unfortunately, different weapon system programs currently use different combinations

of these numbers, among others (e.g., the NSN), to manage selected items. Currently, exclusive use of these three attributes has significant drawbacks:

- On certain parts, the part number may change following the inclusion of a modification.
- Historically, manufacturers have had no obligation to ensure that serial numbers are unique within their CAGE code.

Unqualified reliance upon these three elements for identification purposes could result in duplicate identities with the subsequent loss of information. The selection of an appropriate standard for uniquely identifying parts is necessary for a sound AIT strategy and selection should be made after consideration of the following criteria:

- The standard must guarantee uniqueness, not only amongst the parts currently within the Army inventory, but for all new parts that are liable to enter that inventory.
- The standard must guarantee uniqueness for parts that cross the AME boundary.
- The standard must be technology and media independent.
- The standard must be compatible with both automated and legacy forms–based maintenance processes.
- The standard must be appropriate to the fullest range of business processes possible.

To meet these criteria, and to facilitate the full functionality of the AME, the Con-Ops adopts all three attributes for unique item identification. However, in addressing data issues in transitioning to the AME, additional attributes are added for in-service parts. These attributes are required to specifically identify items produced under past and current manufacturing standards for item identification. Currently, manufacturers cannot guarantee a part number and serial number will uniquely identify an item under a single CAGE—the result of the prime manufacturer's sub-contractor, or a secondary facility, using the prime manufacturer's CAGE code, which does not conform to a single, internal numbering system. Therefore, additional attributes eliminate duplicity of unique identifiers found within a single CAGE code—duplicity caused by disparate manufacturers' information systems.

During the transition phase, when in-service parts are marked, it is necessary to access and maintain a database to cross-reference the new, unique identifiers with the legacy part identification information. Using the new attributes, this database provides a link to the part history for newly identified components. Some manual intervention is required to reconcile the duplicate instances of parts identifiers.

Once accomplished, however, all new data are assigned to the new number, associating newly numbered parts with their old history and identification.

Eventually, as the AME becomes fully functional, these additional attributes lose their relevance. Manufacturers guarantee all newly produced parts are unique and compliant to new production identification standards. At that time, the AIS can readily cross-reference all existing part identifiers before accepting an item into the database or approving assignment of a unique identifier to an in-service part. This is accomplished invisibly by the AIS and ensures parts tracking is virtually error free—due to the elimination of duplicate part identities.

IDENTIFICATION OF CANDIDATE PART TYPES FOR TRACKING

With a typical aircraft structure hierarchy holding approximately 10,000 parts, it is not practical or cost effective to track each part. Parts within the structure must be classified in order to develop a priority for tracking that addresses the business need in the most timely and cost-effective way. The suggested classifications in Table 4-1 are prioritized by their effect on business practices. The necessary business impact is likely to be achieved by marking and tracking less than 5 percent of the unique part numbers.

Table 4-1. Suggested Classifications

Flight safety–critical parts	
Business impact: Safety	Time-managed parts (parts that have a measured maintenance, operating, retirement, or overhaul limit) Structurally significant parts (parts that are structurally significant to flight safety)
Configuration-significant parts	
Business impact: Capability	Operational and handling significant (parts that extend/restrict performance operation or flight characteristics, crew requirements or crew training) Role significant (parts that extend/restrict role or flight profile capability)
Managed parts	
Business impact: Readiness, sustainment, or cost	Process significant (critical to build or rebuild—for example, custom fitted doors) Maintenance significant (time, manpower, facility, or skill) Logistically significant (lead time, transport, shelf life, storage durability) Re-capitalized parts (for "re-cap" item performance and asset tracking) Repair and overhaul parts (for repair and overhaul performance and contract tracking) High value (cost)

Identification and Selection of Appropriate AIT

The informed selection of appropriate marking technology is critical to an organization's ability to realize the full benefits achievable through AIT. It is important to maintain an enterprise view, with the full range of functional areas required to interact with the AIT being given due consideration.

All AIT can uniquely identify an item, some by the manufacturer's code, item serial number, and part number (in accordance with emerging DoD and industry standards); however, different AIT devices are technically suited to different AIT approaches. Certain suites of AIT devices are more applicable to different functions, procedures, and processes of the AIS. The two main technological approaches to AIT are

- direct parts marking (DPM) in the form of labels or direct marks, and
- electronic media (EM), such as contact memory buttons (CMBs) or radio frequency (RF) tags.

The Con-Ops recognizes that the needs of all potential AIT users cannot be achieved by a single technology. In order to realize commonality and consistency, both across business areas and with vendors, a concept of a prime technology and supplementary technologies is required. The definitions of the prime and supplementary AIT are as follows:

- *Primary AIT* acts as the lowest common denominator, satisfying the large majority of the AIT needs. The primary AIT provides the leading standard and methodology in developing automated data acquisition processes.
- *Supplementary AIT* are used in the minority of cases to satisfy the specific AIT needs of individual business areas and processes. These supplementary technologies are used only as necessary and in addition to the prime technology.

Both the primary and supplementary part-marking technologies must host, at a minimum, the unique part identity. This enables access into supporting information systems to enter or retrieve more detailed information against a specific part. The supplementary technology can host additional information as required by the specific business process supported.

To ensure the prime part-marking technology provides a cost-effective, working solution, which does not rely upon proprietary equipment and can use industry-standard readers, the prime part-marking technology must use commercially accepted standards. These standards need to address three specific attributes:

- *Syntax.* The agreed upon standard that defines the storage criteria for the information. This standard ensures that the information can be read by non-proprietary, industry-standard readers.
- *Semantics.* The agreed upon data standard that defines the meaning of the data such that computer applications can use it as a template to correctly interpret the data once read. This allows all applications within the AME that could benefit from AIT to develop effective, cost-efficient solutions.
- *Uniqueness.* Included within the standard is the specification for the unique identification of individual instances of parts. This ensures that all parts marked with the prime marking technology have a unique identity.

The DoD is working with industry to establish standards to address these aspects; however, linear bar codes are presently the only technology that has associated standards that address all three aspects. Table 4-2 provides a detailed summary of the technology characteristics that were reviewed for acceptance as the primary AIT for the AME.

Table 4-2. AIT Characteristics

Technology	Data capacity/range	DoD standards	Strengths	Weaknesses
Linear bar code	~20 characters/ Close, line-of-sight	Code 39	Inexpensive, disposable, part of DoD and commercial business practices, and established standards	No updates, low tolerance to damage, pre-positioned data required for effectiveness, human involvement required
2-D bar code	1,850 characters/ Close, line-of-sight	PDF-417 for logistics, Maxicode for sortation	Inexpensive, several layers of redundancy, durable, pre-positioned data not required, 2-D scanners can also read linear bar codes, established standards	No updates, human involvement required
OMC	2.4 MB/Contact	DELA	Can withstand harsh environments, inexpensive, established standards	Reader-writer not portable (cabled to personal computer), slow data transfer rates, human involvement required
Contact memory button (emerging technology)	3 KB to 8 MB/ Contact	Semantics: ANSI MH10.8.2 ISO 15418 Syntax: ANSI MH10.8.3 ISO 15434	Relatively low cost, programming read-write capability, robust tags for harsh environments, rapid data transfer rates, 100-year life expectancy	Cannot be read remotely; cannot be used on small parts, internal gears, or in extremely high-temperature areas; proprietary design

Table 4-2. AIT Characteristics (Continued)

Technology	Data capacity/range	DoD standards	Strengths	Weaknesses
RFID (passive)	Up to 20 bytes/ Inches to 240 feet, line-of-sight	None	Quick data-transfer rates, no battery required for interrogation, some read-and-write capabilities, inexpensive, durable, reusable, established standards for commercial transportation applications	Line-of-sight interrogation, moderately expensive, subject to hostile detection and integration
RFID (active)	Up to 128 KB/ Inches to 300 feet (omni-directional)	J-DTAV	Omni-directional interrogation, reusable, read-and-write capabilities, durable, no human involvement required	Battery required for interrogation, moderately expensive, subject to hostile detection and integration
Movement tracking system	Extensive/ Long-range, line-of-sight	None	Precise location of conveyance, two-way communication, able to redirect vehicle in minutes, no human involvement required	Expensive, equipment needed in each vehicle to allow communication between the dispatcher and host system

Notes: ANSI = American National Standards Institute; DELA = Drexler European Licensee Association; ISO = International Standards Organization; J-DTAV = Joint Directed Total Asset Visibility; MH10 = materiel handling (standard 10); OMC = optical memory card; MB = megabytes; PDF-417 = Uniform symbology specification as defined by the Automatic Identification Manufactures (AIM); RFID = radio frequency identification.

The rationale for selection of a primary AIT is intrinsic to the system design and the processes that are served within the AIS. As briefly discussed in Chapter 3, there are two fundamentally different approaches to the use of AIT within an AMS and its subsequent relationship to the supporting AIS. Each approach is, in turn, dependent on different AIS architectural and operational designs—and their supporting data access and storage capabilities. The core difference of the two AIS methods is evident in their data handling characteristics. One system uses a decentralized data management system, with a restricted connection between the AMS to AIS; the other relies on a centralized database management system, with an extensive ability to instantly retrieve and pass data to and from the AIS through the AMS.

Data Matrix and Bar Code

The most applicable primary AIT device employed within a centralized data repository AIS/AMS is the direct parts-marking method, with data matrix symbols or bar codes. This type of AMS relies upon the AIS for all essential and pertinent item data and relies upon the AIT device or symbol for only an accurate identification of the item. The data matrix symbol can be sized as small as one-eighth square inch. This provides greater opportunity for placement onto smaller items. In addition, the data matrix and barcode symbols can be applied directly to a part through permanent and non-permanent parts-marking methods. This creates even

more opportunities for AIT—the range of identification can extend to the internal components of an assembly (e.g., gears, bearing races, turbine engine compressor blades, etc.). This places a greater level of granularity and accuracy into automated record keeping and configuration management.

By using direct parts marking, in conjunction with the centralized database AIS, synchronization of the changing data is not an issue; it becomes a function of the central repository and the AIS. This is supported by the underlying AMS, without the requirement for collocation to update and synchronize reference data.

The data matrix and bar codes are variable in size, but standardized to contain the specific data elements that make up the item's unique identity. In addition, data symbols can easily coexist with any human-readable labels already on the item. As stated in Chapter 2, the need to provide a human-readable format is critical to the alternate method of data entry—should an AIT reader or scanner fail or be absent.

Contact Memory Button

A decentralized database type of AMS might find the contact memory button an appropriate AIT, based on local processes. This type of AIT-to-AMS combination relies on the availability of pertinent data necessary for a particular process to reside with the component. This is required much in the same manner as a paper-based, manual system might require a condition tag (also know as a "shoe tag," which lists the item's condition and other essential component or maintenance information). This approach has merit in today's maintenance environment, in that it facilitates a decentralized maintenance operation with a limited capacity for external data communication. However, because the CMB is itself a small database, data synchronization and latency issues must be considered when establishing information transfer requirements and processes that encompass the logistics field.

The CMB is a read-write device that has a programmable memory storage capacity. The memory is relative to the size of the CMB—the larger the memory, the larger the CMB. For most maintenance applications the 32-kilobyte version has become the CMB of choice, which is approximately the size of three dimes stacked together. Consequently, size and placement can be an issue when trying to apply CMBs to small parts.[1]

The greater issue with the CMB is the need to continually synchronize the changing data between the CMB, the AMS, and the AIS. For example, when the reference data specific to a component is changed (for example, a new part number suffix), every instance of that component must be physically accessed and the CMB updated to correct the reference data. This involves extra steps in the

[1] There is some remedy if the CMB can be applied to its next higher assembly.

maintenance data transfer processes, and extra processes and procedures outside the maintenance functional area.

Because the Con-Ops employs a central database AIS, and because it is a system imperative of the Con-Ops that the AMS/AIS must minimize the user's workload, the CMB was not selected as the primary AIT. Consequently, the direct parts marking was chosen as the primary AIT method and enabling device for the Con-Ops' model AIS design.

Centralized Database Approach

The central database approach was selected over the decentralized approach for the sake of commonality and ease of management across logistics functions. This enterprise view had to be considered to achieve the goals of the AME because, when comparing requirements—AIT and the information requirements—across the functional areas (namely, maintenance versus other logistics and business practices) there are significant differences. Maintenance requirements may not serve other functions or processes, and vice versa.

Maintenance is a very dynamic environment that imposes continually changing information about a component during repair and overhaul. One would not expect that as an unserviceable assembly enters into overhaul or a major repair, it would still be the same unserviceable assembly upon process completion—nor would it have the same configuration of parts. A lot happens to a component during its life cycle of use and repair; however, the opposite is true of, for example, transportation or supply functions. These are very static environments. An item entering one end of the supply or transportation system had better be the same item that comes out at the other.

It is this disparity of environmental dynamics that requires a centralized database. The intent is to let the AIS manage the actual item and let the individual logistics functional systems manage the process—all the while preserving an enterprise perspective. The supply and transportation specialists may not need to know on what aircraft a component has been. Likewise, the maintainers do not need to know who packed the item that was delivered. But, the information has relevance to the enterprise and must be associated to the individual component. This imposes a common denominator between information requirements of which unique item identification is paramount.

This enterprise approach to information management is the key criterion in selecting the primary AIT for the AME. A read-write or high-capacity device served the supplemental functions of maintenance as needed; but the primary AIT had to serve the primary functions of both AME and the enterprise.

STRATEGY FOR APPLYING THE MARKS

Marking a fleet of aircraft and associated spare parts is a significant task. The strategy produce the greatest business advantage for the fleet at the lowest cost and in the shortest possible time. The question of how this could be done leads to a conclusion that the probable scenario would be a mixture of *opportunistic*, *seek-and-mark*, and *gated* strategies. Encouraging vendor-marked-at-source parts contracts in the future is important for sustainment, but has limited impact on a retrospective marking program.

Opportunistic Parts Marking

Opportunistic parts marking (OPM) can be done in the field or factory, wherever it is convenient to gain access to parts either on an aircraft or available in a storage facility.

Projected situations or processes where OPM might be deployed include the following:

- Phase maintenance
- Scheduled servicing
- Depot rebuild or overhaul processes
- Work-order processes during modification.

Seek-and-Mark Parts Marking

The seek-and-mark parts marking (SMPM) strategy can be used for particular parts held within the AME, either at the aircraft or in storage. This strategy is dependent on establishing the location and availability of parts before deployment of marking equipment and teams. The location of parts can be determined through the supply chain management information systems and inventory control systems. The SMPM approach is considerably more expensive than OPM, is dependent upon good legacy data, and will demand greater overhead of coordinated effort to effect access to the assets. By concentrating marking efforts, the advantage is faster fielding of configuration management for specific parts.

Intercept Gate Parts Marking

The interception of parts as they transit specific gates within the supply chain can ensure no part enters the AME unmarked. Having identified an unmarked part at the gate, the situation can be resolved in a number of ways:

- Diversion of the part back to vendor for marking
- Provision of a marking capability at the specific supply gate
- Diversion of the part to a centralized marking facility.

Vendor Marking at Source

This is a long-term goal for any program. Vendor marking at source (VMAS) provides a relatively cheap and unobtrusive marking option; however, it will not provide the speed of response necessary to successfully implement a retrospective marking program. VMAS is an important component of direct parts-marking sustainment, and, if correctly managed at contract, will eventually be commonplace within military contracts, as it is in the public sector.

THE CH-47 EXAMPLE

Taking into account the viability of tracking parts against their true effect on CH-47 sustainment, there are approximately 400 unique parts on each aircraft that need the direct parts-marking process. No single strategy for applying marks is likely to fulfill the objectives of time and cost. Therefore, a mixture of OPM, SMPM, intercept gate parts marking (IGPM), and VMAS strategies is suggested. Table 4-3 is an estimate of a possible mix of these strategies.

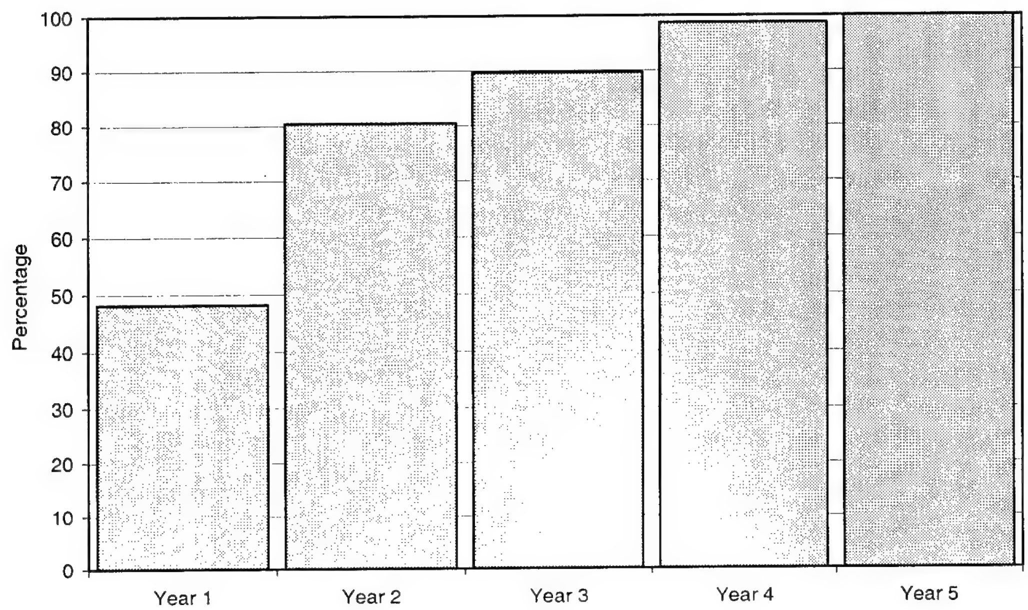
Table 4-3. Estimated Percentage of Parts Marking

Marking strategy	Coverage (%)	Time (years)	Business impact	Comments
OPM	62.5	2	High	Most cost effective, short to medium term
SMPM	<1	<1	High	Immediate coverage of extremely important parts—only needed in exceptional circumstances
IGPM	37.5	2–4	Medium then low	Long term—initially high throughput, dropping off dependent on stock turnaround when VMAS will take over
VMAS	Unknown	5–10	Low	Long term—cost absorbed within process or cost of part

Notes: *Coverage* is an estimate of the total parts population in the domain that might be marked using the marking strategy. *Time* illustrates a raw estimate of the time required to mark the relative population percentage using the strategy. *Business impact* is an indication of functional return on investment for the strategy.

Using these methods, it is expected that the full spectrum of targeted parts could be marked within 5 years. Figure 4-3 illustrates the percentage of parts that would be marked within a 5-year period.

Figure 4-3. Percentage Marking Coverage



For the parts-marking and AIT considerations above to become an implementation strategy using the three-state approach—implementation, transition, and objective—the following characteristics are required at each stage.

AIT in the Inception State

The following activities will be underway during the inception state:

- Classification of the unique identification standards to be applied, including the impact on current tracking data
- Identification of the candidate parts types to be tracked
- Identification of the appropriate technology for specific part types
- Identification of a process to enable application of the identified AIT across the fleet in the most timely and cost-effective manner. This includes processes for ensuring approved and consistent application of both unique identification and AIT to parts at diverse locations.

AIT in the Transition State

The marking of the parts is only the initial stage in the realization of the full benefits of AIT. Not until the part and its associated data are integrated into the AME can these benefits be achieved. The objective state is the goal, but the transition environment is the challenge. It may take a significant amount of time to achieve the desired level of parts marking for the objective state, let alone have all these parts inducted into the AME. During this transition period the following situations will occur:

- ◆ Weapon systems will be configured, with varying combinations of marked and unmarked parts being managed and maintained in an automated environment.
- ◆ Weapon systems will be configured, with varying combinations of marked and unmarked parts being managed and maintained in a manual environment.
- ◆ Weapon systems will be configured, with varying combinations of marked and unmarked parts possibly migrating between automated and manual environments.
- ◆ Parts, whether marked or unmarked, will migrate between manual and automated maintenance environments.

These combinations are inevitable, especially in the early stages of transition. In order to provide the necessary flexibility of part migration, a part must have only one identity—whether marked or unmarked. It would be extremely restrictive and detrimental to operational availability to establish two distinct operating domains in terms of parts.

AIT in the Objective State

The AIT objective state is characterized as follows:

- ◆ More than 90 percent of parts identified for tracking are marked and integrated into an appropriate AIS.
- ◆ All vendors mark new parts in accordance with agreed to standards.
- ◆ All new aircraft entering the AME have all parts marked in accordance with agreed to standards.
- ◆ There is a process in place to manage an unmarked part within the AME.
- ◆ AIT is incorporated into all maintenance and support processes.

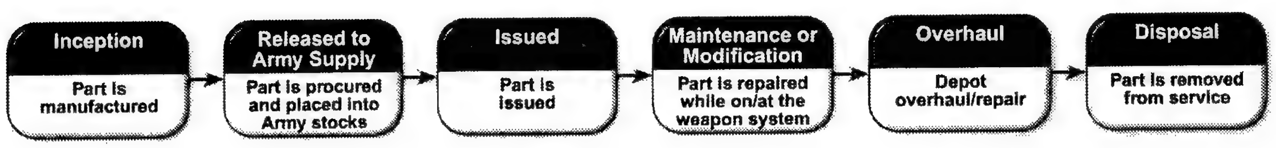
AIT AND THE COMPONENT LIFE CYCLE

A part's life cycle includes the following stages, from manufacture to disposal, as illustrated in Figure 4-4:

- Inception of the part at the OEM.
- Release to the Army supply system.
- Issue and installation on a weapon system.
- Maintenance and modification while on or at the weapon system.
- Overhaul and repair at a depot repair facility.
- Removal of the part from the Army system.

These life-cycle stages rely on certain functions of the AIS. Although, certain functions are not applicable to all parts, some are. Therefore, all life-cycle stages are applicable to all components, but in varying degrees. An example is the recoverability of certain items when they are removed from service. Some items are thrown away, while others might be processed for recycling. This may factor into a cost recovery, which is applied to the total component life-cycle cost.

Figure 4-4. Component Life-Cycle Flow



Inception

Using the appropriate AIT method, the OEM marks the new or remanufactured part during its production or assembly with a unique identity. History, usage, and configuration data are linked inextricably to that part via its unique identity within the supporting AIS. If the part is installed to a weapon system at the point of manufacture, the AIT will support the compilation of an electronic "build" record with accompanying maintenance particulars, within the AIS.

If the part is released independently to the supply system, any usage, maintenance, configuration, and subassembly details are automatically linked to the part via the AIS. AIS information is transferred directly into the user's database and provides accurate updates on supply assets.

Even if the OEM cannot interact directly with a user's AIS, AIT still allows the manufacturer to update records on components that pass through or are used within the facility. If a part is returned to the OEM for overhaul and reconditioning, accurate identification, which is tied to the usage history, enables warranty tracking and reliability assessments. At this point in the life cycle, the AIT functions introduced or utilized center around the following:

- ◆ Configuration management
- ◆ Parts inventory
- ◆ Aircraft build record
- ◆ Bill of materials
- ◆ Warranty usage tracking
- ◆ Reliability assessments.

Release to the Army Supply System

The new part is received into the supply system already marked by the OEM with the appropriate AIT. Some parts may come from manufacturers without AIT applied. That is why Army policy directs opportunistic parts marking to ensure consistent and accurate marking of parts wherever it is most appropriate.

The unique item identification is machine read directly from the part and entered into the AIS supply database. Interaction within the AIS provides history and usage, maintenance, and configuration details. Even without immediate association to a component's history, AIT feeds the supply system accurate information on where, what, and how many parts are held.

Detailed and accurate tracking of part usage provides the data necessary for performance-based logistics support functions. Optimized repair, storage, and distribution functions in the AIS—enabled by AIT—create life-cycle cost efficiencies for the respective weapon system. At this stage, the AIT functions introduced or utilized center around the following:

- ◆ Electronically provided forms (paperless system)
- ◆ One-time data entry requirements
- ◆ Ready identification of asset visibility (part location, availability, new or reworked) by accessing the total asset visibility (TAV) database system via the communication network
- ◆ Automated parts ordering

- Automated priority status
- Expedited approval through the communication network
- Online, real-time parts tracking
- Performance-based logistics.

Issued and Installed

Upon receipt of a marked part, the AIT information is used to populate the AMS and complete the AIS database regarding the location and other pertinent details. The identification, historical, and configuration details are checked to confirm the part can be used on the designated weapon system. Configuration changes are verified to ensure part compatibility before any maintenance operations are started. If the operational unit receives an unmarked part, the customer using OPM practices—as established by Army policy—can mark it.

When any maintenance action involving the part is registered within the AMS—history, usage, and configuration details—it is transferred directly into the AIS. If the configuration has changed, the AIS will show any new maintenance or operating parameters based on integrated technical data. In addition, the AIS captures the issue transaction, from supply to the platform, and automatically requests a replacement if proper parameters are met. At this stage of the life cycle, the AIT functions introduced or utilized center around the following:

- Asset management, including parts availability and error-free asset data
- Shop management between AVUM and AVIM
- Configuration management
- Weight and balance data
- Updated maintenance schedules
- Aircraft inventory
- Supply requisitions
- Personnel training
- Readiness reporting
- Usage history.

Maintenance or Modification

When using an AIT-marked part in maintenance operations, all necessary information is obtained directly from the AIS. If supplementary AIT is used (such as CMBs), information is obtained directly from the part, which is later updated into the AIS.

If a modification action prompts a required change in the maintenance or operating parameters of a part, or to the respective system, the AIS automatically captures the new configuration (through relative data within the AIS) and automatically updates the technical data at all operating nodes. Likewise, the supply database within the AIS shows the updated location and configuration of the part as it is installed. If the part is repaired and reinstalled, AIT ensures accurate recording of the part history within the AIS.

On receipt of a safety-of-flight message, accurate part identification and location data enable immediate and direct action. This avoids nugatory location searches for affected parts by individual physical inspection of serial or part numbers. The same methodology applies to managing maintenance work orders and technical bulletins. At this stage of the life cycle the AIT functions introduced or utilized center around the following:

- Asset management, including parts availability and error-free asset data
- Intra- or intershop management
- Previous repair data
- Safety of flight, maintenance work orders and technical bulletins
- Configuration management
- Weight and balance data
- Updated maintenance schedules
- Aircraft inventory
- Supply requisitions
- Personnel training.

Overhaul

At the depot, the part identity is established by the incoming part's AIT. The maintenance history of that part is read by linking to the AIS. Its usage and configuration determines the maintenance actions required within the depot. If the part is received unmarked it is subject to OPM.

When subcomponents or systems are replaced or refurbished on the parent assembly, the usage and configuration details held within the AIS are automatically updated via the AIT or via manual entry. Direct AIT reading of subcomponents and assemblies allows all materials used or consumed to be annotated accurately and updated, as required by the maintenance processes.

Examination of component failures, supported by the AIS history files, allows reliability assessments to be made. Preventative maintenance effectiveness is also measured by an accurate record of the maintenance operations performed on the component or subcomponents.

At the end of its service life, the part details and history are archived within an AIS-connected database. At this stage of the life cycle the AIT functions introduced or utilized center around the following:

- Failure rates assessments
- Maintainability assessments
- Reliability assessments
- Reliability-centered maintenance assessments
- Engineering analysis
- Accurate bill of materials
- Data archiving.

Disposal

As an item is condemned or no longer considered serviceable in accordance with Army standards, it is identified by the appropriate condition and recoverability codes within the AIS. Disposition instructions are outlined according to precedence or on a case-by-case basis via the item manager.

The item is shipped to the proper facility for disposal or reuse. Items requiring demilitarization are annotated via the AIS when the action is complete and are certified according to station and authority. All associated component history and data are removed from the active component database and archived accordingly. The active database retains the component-unique identifier for accountability purposes. All items processed for reutilization are annotated accordingly, then reassigned within the database structure.

Notification of a loss of Army inventory is processed by the AIS and disseminated to the respective managing entity to initiate procurement processes if needed. Costs recovered through recycling or scrap sales are associated to the component for total assessment of its life-cycle cost.

At the end of its service life, the part details and history can be archived within the host supply or AME system. The part is shown as being removed from the supply chain and no longer available as an asset; however, its history is still available to support further trend analysis.

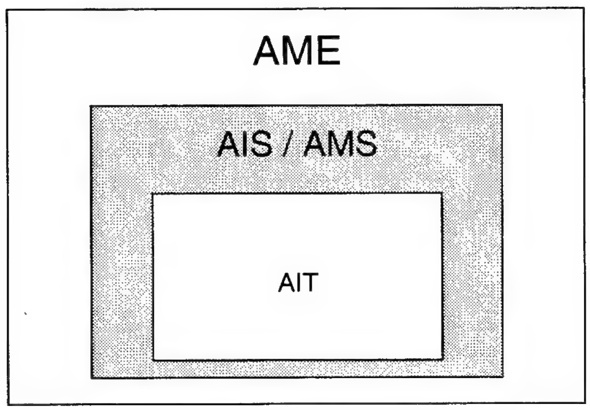
At this stage of the life cycle the AIT functions introduced or utilized center around the following:

- Demilitarization
- Accurate financial accountability
- Proper disposition to or from the Defense Reutilization and Materiel Office (DRMO)
- Accurate asset accountability
- Procurement notification
- Recoverability of recyclables and other unique items
- Cost recovery through recycling or scrap.

Chapter 5
Architecture

This chapter describes a proposed AIS technical architecture, and provides the reasoning behind particular design tradeoffs and decisions. The proposed architecture is designed primarily to meet the needs for data collection and analysis. Still, the architecture significantly improves asset visibility and management, increases the go-to-war capability assessment function, and provides the maintainer with an enhanced information environment. Figure 5-1 is a modification of Figure 4-1, and is presented to emphasis the relationship of the AIS/AMS to the overall AME.

Figure 5-1. AIS Within the AME



Architecture Goals

Before providing a detailed description, it is important to present an overview of the following primary goals that the architecture is designed to provide:

- Organizational integration
- Data collection
- Data accuracy
- Data analysis
- Data visibility
- Scalability and extensibility
- System administration.

Organizational Integration

The architecture will integrate the sustainment base (e.g., program managers [PMs], Program Executive Officers [PEOs], IMMCs, Army Materiel Command [AMC]), the command (e.g., G-4, S-4, division support staff, unit-level

managers), and the maintainer (namely, maintenance managers and mechanics), with the aim of providing each with the best information, to enable the optimization of the work performed.

The proposed architecture recognizes that the information needs of the sustainment base, the command, and the maintainer are different in scale, source, content and frequency of update. Therefore, architecture's design seeks to collect, handle, and present the different information in the most appropriate manner, with the goal of providing a system that meets the needs of all groups of users without increasing the workload of any one group.

Data Collection

The AIS architecture must ensure the commander and the sustainment base managers have improved asset visibility. The sustainment base managers, and OEM and major suppliers must have enhanced visibility of maintenance processes as well. To be successful, improved visibility must be achieved through the collection of data from the maintainers while simultaneously enhancing their capability and performance by the provision of accurate information.

Fundamental to this end is the system's ability to collect data about the maintenance performed with no extra effort or data input from the maintainer. The level of automation should provide the data in a way that simplifies the maintainers task and reduces the number of processes required to perform maintenance or supply actions or functions.

Data Accuracy

This architecture must provide accurate data about the serviceability state, location, and configuration of aircraft and components, as well as the maintenance activities. For this level of accuracy and intelligibility, the classification of data entered and the minimization of manual data entry are fundamental. The AIS architecture, therefore, maximizes the direct entry of data through use of AIT-marked parts and the maintainer's selection of predefined classifications of input.

Data Analysis

The architecture will provide a reliable and timely source of maintenance data for analysis, enabling visibility of the primary cost and time drivers in order to minimize weapon system operations and support costs. This involves the collection of maintenance data from wherever maintenance is performed (from AVUM to depot) and the access to data via a controlled data warehouse—the "Info Center."

Data Visibility

This architecture must ensure all weapon system support data are available and presented in a manner that supports the required business functions. Data availability can be realized when forward support units are operating from main operating bases with good communications links and are on mobile or tactical deployment with only limited or no online communications facilities available.

To achieve good data availability, the architecture must ensure data can be transmitted via a variety of modes (e.g., disk or tape) to accommodate conditions when online communications are unavailable.

Scalability and Extensibility

A scalable architecture will enable expansion of the number of users and the units or organizations serviced by the system, without any significant change to the system (other than the addition of the appropriate installations and communications).

An extensible architecture will enable additional functions (such as embedded diagnostic systems or a health and usage monitoring system) without significant change to the existing elements of the system.

Integral to scalability and extensibility is the adoption of modular physical and application architectures. In addition, using open system standards (e.g., joint technical architecture [JTA] and other industry initiatives) wherever possible within the architecture greatly enhances the extensibility of the system, enabling the evolution of the system over time by the addition of commercial off-the-shelf (COTS) elements.

System Administration

For the AIS to operate successfully in an Army environment, it must require only minimal system specialist or database administrator support at forward operating bases. The absolute minimum of administration responsibilities must be asked of the operational users; but the AIS must provide the greatest reliability and performance.

ARCHITECTURE OVERVIEWS

The proposed AIS architecture is presented here as a set of different system perspectives. These show all major, operational concepts, functional areas, user environments, installations, and connectivity variants.

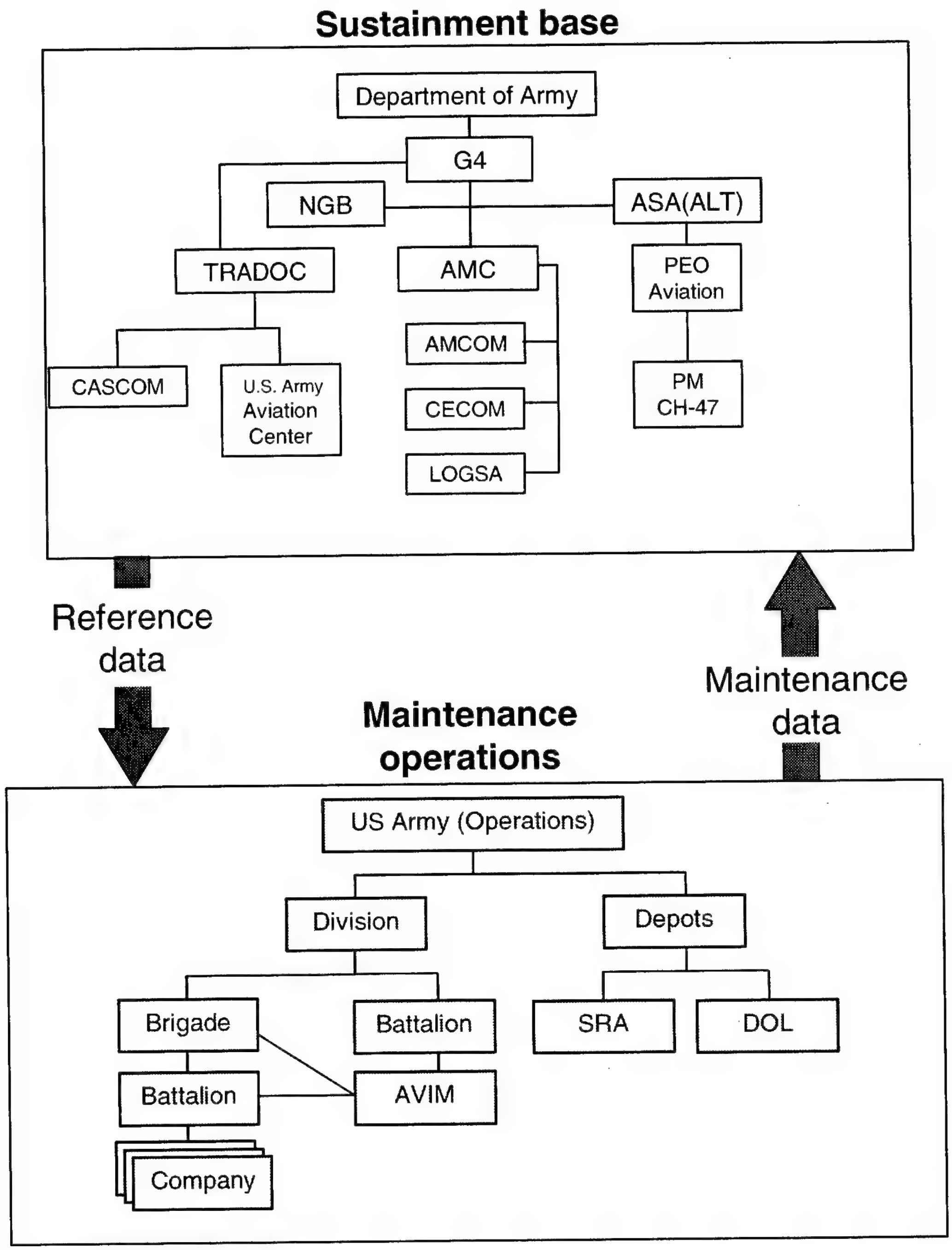
In the subsequent subsections, the following AIS architecture perspectives are described, the relationships among the them are explained, and the major components that constitute the system are identified:

- Organizational
- Operational
- Nodal
- Reference data
- Maintenance data.

ORGANIZATIONAL ARCHITECTURE

Information systems provide information to people in order to enable or enhance their ability to perform work. Therefore, an understanding of the various organizations that will directly use or have a stake in the AIS is essential. Figure 5-2 illustrates the CH-47 sustainment community, its relevant commands and stakeholders in the AIS (relative to the CH-47), and presents the general organization of operational unit users. In addition, the two primary types of data within the system—reference and maintenance—are identified.

Figure 5-2. AIS Organizational Architecture



Notes: AMCOM = Aviation and Missile Command; ASA(ALT) = Assistant Secretary of the Army for Acquisition, Logistics, and Technology; CASCOM = Combined Arms Support Command; CECOM = Communication and Electronics Command; DOL = Director of Logistics; LOGSA = Logistics Support Activity; NGB = National Guard Bureau; SRA = special repair activities; TRADOC = Training and Doctrine Command.

In the above diagram, organizations are presented in two categories:

- Maintenance operations are directly involved in either the performance of maintenance or in the day-to-day management of maintenance activities (those that are involved in the day-to-day use of the AMS/AIS to manage maintenance or otherwise use the system for asset visibility for command purposes). Maintenance operations include the special repair activities and the maintenance conducted under installation DOL programs.

- Sustainment bases supply, manage, or influence the sustainment base, but are not necessarily involved in the day-to-day maintenance of the weapons system or sustainment functions of the AIS. The following organizations are only a general representation of the sustainment base structure:

  - Department of the Army (the executive-level command)
  - National Guard Bureau
  - Assistant Secretary of the Army for Acquisition, Logistics, and Technology
  - Program Executive Office–Aviation
  - Program Manager Cargo Helicopters
  - Training and Doctrine Command
  - Combined Arms Support Command
  - U.S. Army Aviation Center (USAAVNC)
  - Army Materiel Command
  - Aviation and Missile Command
  - Communication and Electronics Command
  - Logistics Support Activity.

There are two primary information flows between these two groups:

- Reference data determine the design and operation of the sustainment base, the support command, and the maintenance operation. Reference data determine how maintenance is both managed and performed. This includes processes and procedures, detailed task descriptions (e.g., e-card data or IETM), task frequencies, fault isolation procedures, and mandatory reporting requirements. In essence, reference data constitute the maintenance policy for the aircraft and its components that will be implemented

and enforced by the AIS. The same set of reference data is held by all organizations that perform, plan, or manage maintenance.

Reference data are updated relatively infrequently. When they are, the data go through a formal release mechanism before the update is distributed to the maintenance units. Because the reference data are fundamental to airworthiness, it is important that, once an update is released, it is received quickly by all maintenance organizations. Thus, the AIS architecture must ensure changes to reference data can be rapidly and reliably transmitted to all appropriate maintenance organizations and units in all geographical locations and operating environments. This is achieved by the provision of multiple communication mechanisms, including transfer by physical media for use wherever local area network (LAN) or wide area network (WAN) communications cannot be established. Also, a data transmission priority is implemented to ensure that, throughout the AIS, reference data always receive priority over maintenance data.

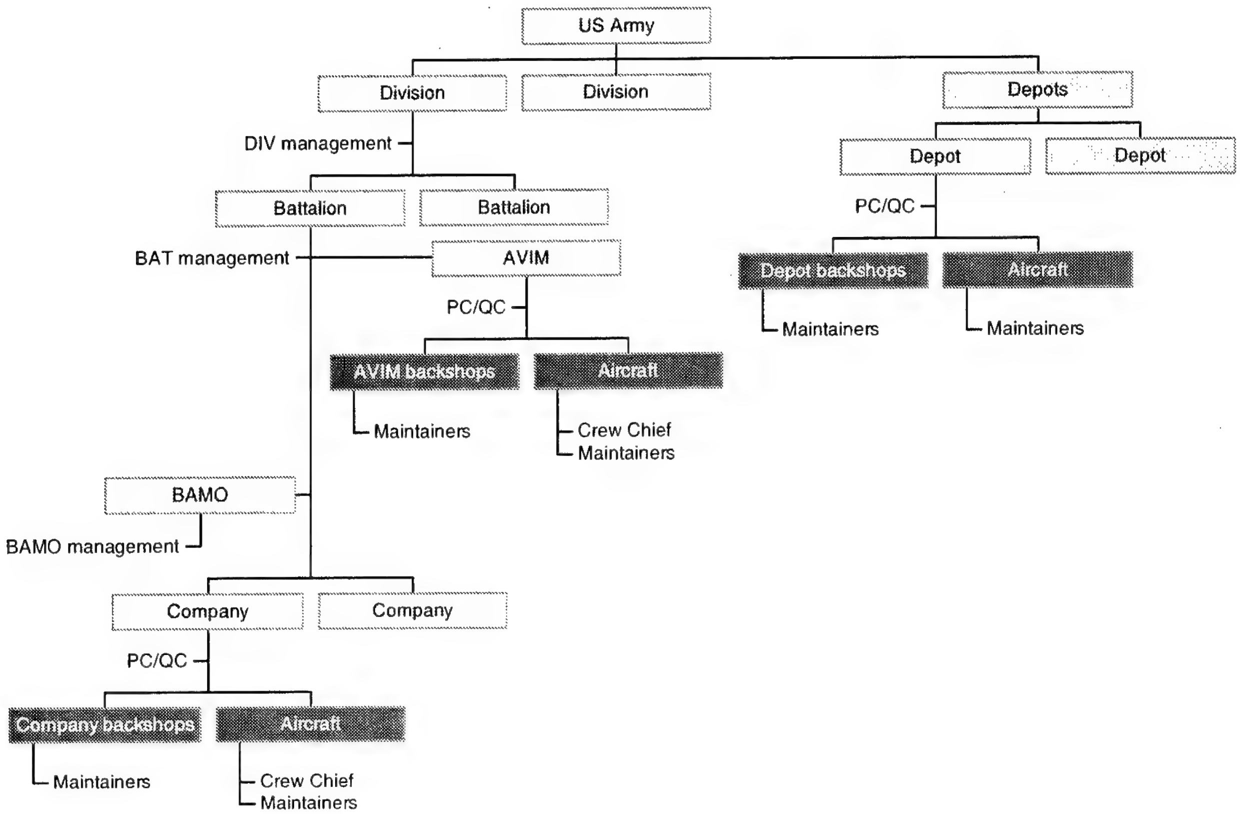
- Maintenance data enable the feedback of the data collected during maintenance throughout the life cycle of a component or weapon system. These data include the configuration state of each aircraft or asset, the readiness state, details of each task performed, and the maintainer's observations on the task descriptions.

  Maintenance data are generated continuously by all organizations and units performing or planning maintenance. In addition, while much of the information is time critical to the operating units (e.g., readiness reporting), it is not necessarily time critical to the sustainment base (as it is used primarily for long-term analysis). Thus, confirming the transmission of most maintenance data should take a lower priority than reference data confirmation.

OPERATIONAL ARCHITECTURE

This section provides an overview of the operational AIS stakeholders who either directly use the AIS set within the framework of their operational command and the control structure, or who are supplied with data (either directly or indirectly) from the AIS. This overview is represented in Figure 5-3.

Figure 5-3. AIS Operational Architecture



Notes: BAMO = battalion or brigade aviation maintenance officer; PC/QC = production control/quality control.

It should be understood that, while data are only entered and updated by the users (during the performance of maintenance or maintenance planning), the AIS architecture provides reports—based on access to all support information (subject to access permissions)—for all operational organizations shown in Figure 5-3.

In most operational scenarios, there is an established communications infrastructure for all units, even when deployed; however, this cannot be guaranteed. Therefore, all units performing or managing maintenance must be able to operate when deployed, without dependency on high-bandwidth, online communications. Units must be able to operate for limited durations in circumstances where there are no communications (e.g., when recovering a combat-damaged aircraft). To achieve this, operational units that perform or manage maintenance must have direct access to a local data repository carried with them wherever they are operating.

Therefore, each of the units represented in the figure by the darker boxes has its own data repository and can operate in isolation from the AIS central repository for a limited time. Extended operations require, at a minimum, a database refresher and historical activities upload (AMS to AIS link-up conducted via an alternate medium) to keep the unit current and the AIS synchronized.

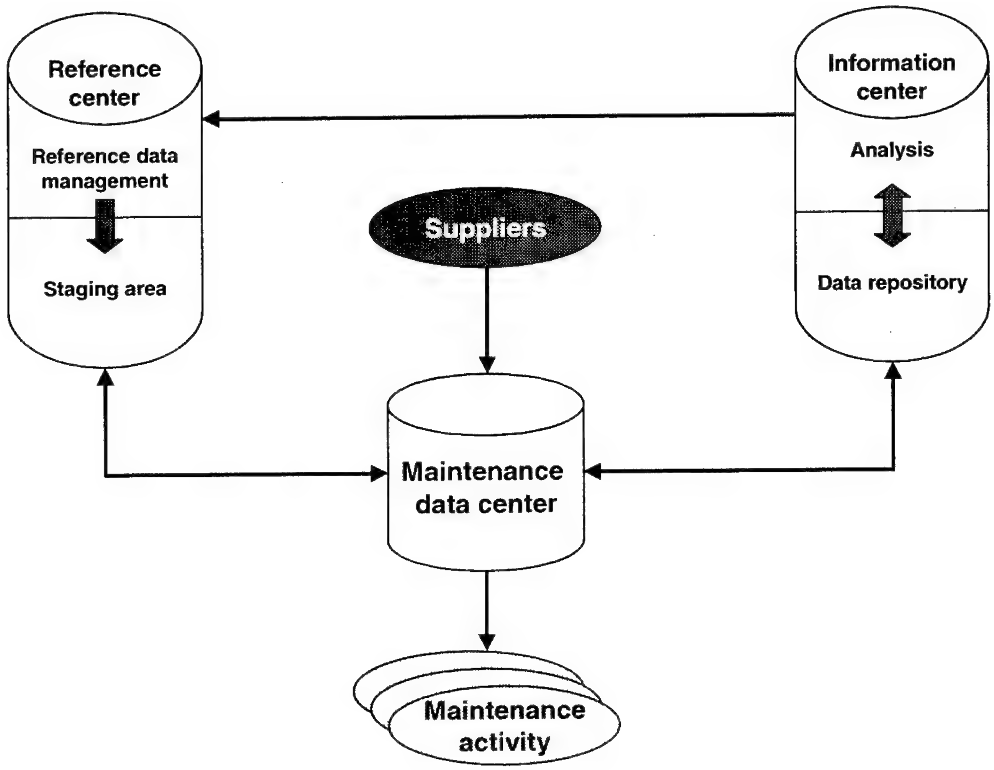
The command and control units (the lighter boxes) need access to information from the AIS through the use of a web-based report system that operates through either a direct or remote connection:

- Direct connection. Wherever a command and control unit is geographically collocated with an associated maintenance unit and connected via a LAN, the reporting system extracts and presents data directly from and to that maintenance unit's local data repository. This requires no external communications links (i.e., no WAN link to the AIS central data repository or World Wide Web). However, the information available in locally generated reports is limited to what is available in the local data repository. Therefore, a command and control unit can gain visibility of all maintenance and management information associated to its maintenance unit. However, no information about any other maintenance unit is available other than those geographically collocated on the same LAN. Wherever a command and control unit is connected via a LAN to more than one maintenance unit, reports can be generated providing information on the activities of each unit (subject to appropriate access controls).
- Remote connection. Wherever a command and control unit requires information from remote maintenance units (where there is no LAN connection), the reporting system will operate over the Web from the AIS central data repository. This enables access to information about any maintenance unit held on the central repository (although subject to valid access controls). The remote-connection web reporting facility will provide the same report coverage as the direct connection. However, due to potential communication delays between the maintenance units and the central repository, remote connection information reports generated from the central repository may not be as up to date as those generated via the direct connection.

NODAL ARCHITECTURE

This section provides an overview of the logical nodal architecture of the AIS. In this description, each AIS installation is referred to as a node. This describes the hierarchical structure of the AIS, defines the generic user types, and defines the type of installation required by each user type. Figure 5-4 illustrates the five primary nodes: reference center, maintenance activity, maintenance data center, information center, and supplier.

Figure 5-4. AIS Nodal Architecture



Reference Center

The reference center node generates and releases the reference data to all nodes within the system. For the AIS to operate, a consistent set of reference data must be held by all nodes. This is achieved by operating a scheduled release process for reference data updates. These releases are transmitted from the reference staging area to all other nodes. The staging area acts to buffer the reference data authoring and management activity from the released reference data held in the live system. Thus, when changes are made in the reference data management arena, they can be authored and validated independent of the live system. The reference data held in the live system will be affected only once the updated data are authorized for release into the staging area and a scheduled update is transmitted to the other nodes in the system.

Maintenance Activity

The maintenance activity nodes are where aircraft or component maintenance, planning, and management of maintenance are performed. The maintenance activities are the source of the maintenance data that are collected for analysis. The maintenance activity nodes exist at three levels within the organizational architecture: the AVUM, the AVIM, and the depot (and possibly the OEM or major suppliers). The nature of the work performed at each is sufficiently similar to enable the same basic architectural structure at all three levels. Independent of the AIS,

the maintenance nodes (particularly the AVUM, and to a lesser extent the AVIM) will deploy for extended periods—possibly in an environment with very limited or no communications. Therefore, the architecture must enable both the update of reference data and the transmission of maintenance data via physical media when a maintenance node is deployed for a significant period (more than 72 hours) without communications.

Maintenance Data Center

The maintenance data center will have no direct user functions. It is provided within the architecture of the central data repository that performs the bi-directional data replication between the other nodes. All reference data to be distributed throughout the AIS will be sent from the staging area to the maintenance data center for onwards distribution. All maintenance data collected at the maintenance nodes (and potentially the supplier nodes) will be transmitted to the maintenance data center for onward transmission to the data warehouse and the analysis and reporting functions.

Information Center

The "Info Center" is the heart of the AIS analysis and reporting functions. A data repository and a set of analysis facilities, including a web-based reporting function, make up the information center. The data repository will hold all maintenance data collected from maintenance nodes (and possibly from OEM and supplier nodes). The collection of maintenance data at the information center and their use via the web reporting system enable all authorized AIS users access to analysis reports, as needed—either directly from a connected system terminal, or from any browser-equipped PC that can access the Web. The analysis function assesses system and component performance, status, and life-cycle trends. Based upon the trend analysis, courses of action by system or by individual component are sent to the data reference node to the unit.

Supplier

The supplier node is an enhancement to the basic AIS, and is not essential to achieve the basic AIS function or goals. However, the inclusion of main suppliers within the AIS boundary may offer a number of advantages. If supplier nodes are included, the architecture of these nodes would be the same as for maintenance nodes. Therefore, this document provides no further discussion of supplier node architecture.

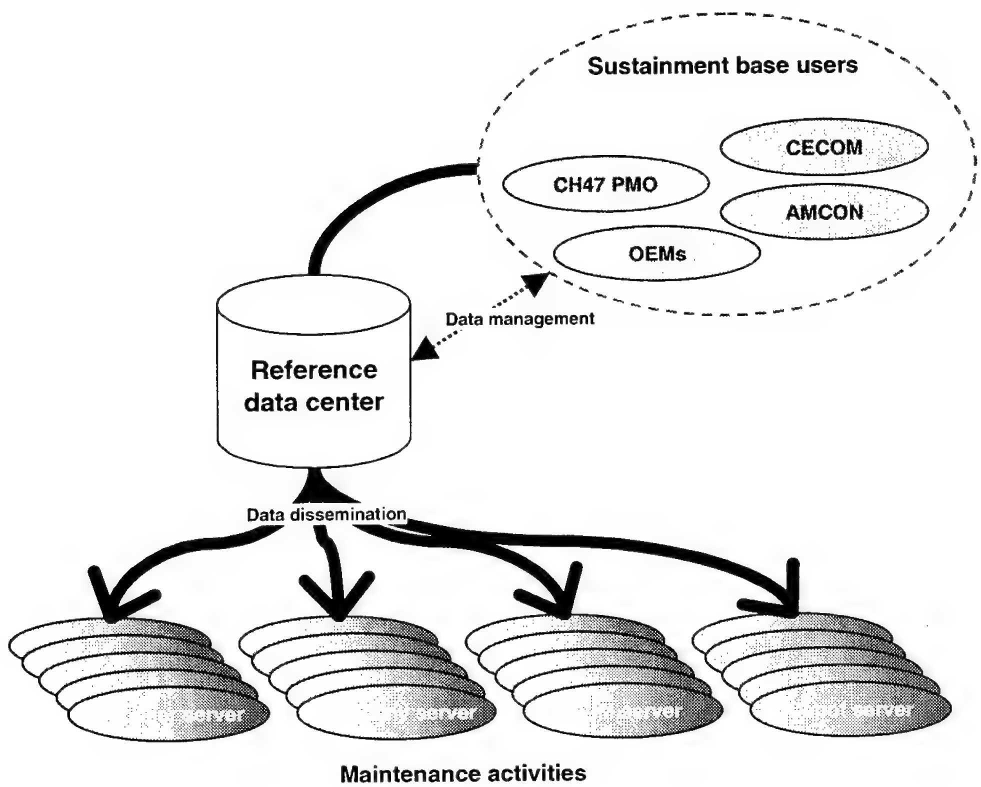
Inclusion of the OEM and suppliers enable the inclusion of depot maintenance operations performed by the OEM or suppliers in the analysis functions and enable a more accurate assessment of the true maintenance costs throughout the product life cycle and maintenance environment. An additional benefit of including the OEM and major suppliers within the AIS boundary is that the supplier

may directly place assets on the system before delivery, rather than the Army having to process new components into the AIS. This will greatly simplify the movement of assets between the Army maintenance organizations and their main suppliers, obviating the need for a boundary control function.

REFERENCE DATA INFORMATION ARCHITECTURE

Reference data flow from the sustainment base to the maintenance units. Identical reference data are held by all maintenance units and continually updated by the reference data node, as depicted in Figure 5-5.

Figure 5-5. AIS Reference Data Information Architecture



Consistency of reference data is critical to the operation of the AIS. Therefore, the assembly of the reference data and their release into the live system must be carefully controlled. The proposed architecture provides a reference data center, from which the assembly, authorization and release will be managed.

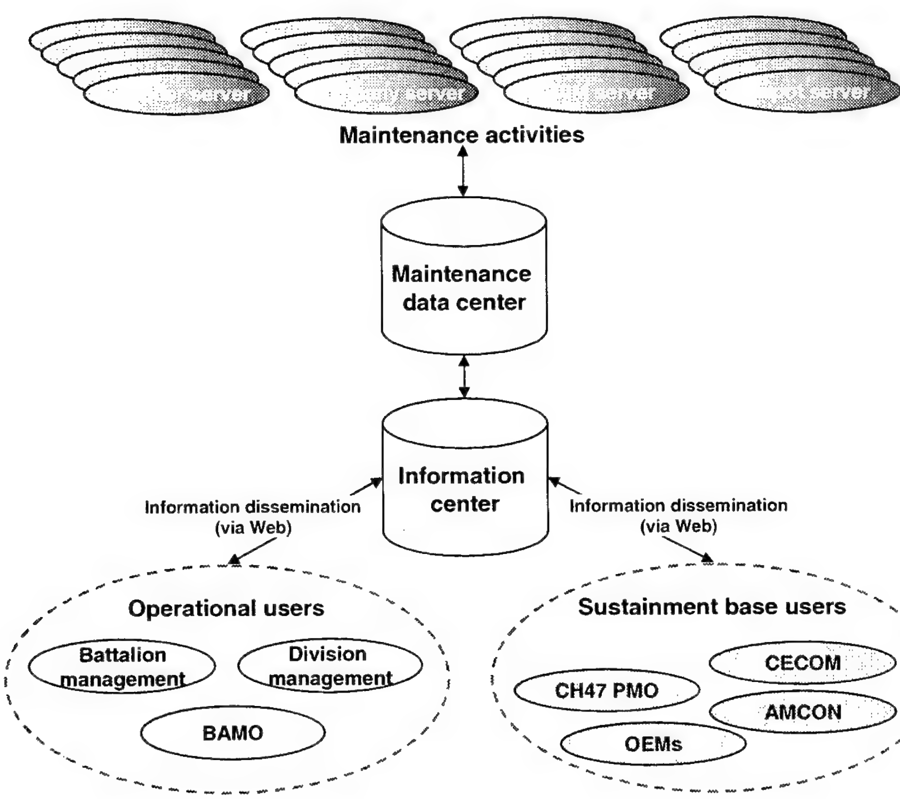
Reference data will be amassed from a number of sources, including the following:

- Project Office, which, in conjunction with AMCOM, will be the source of the majority of policy data.
- AMCOM will approve and issue all safety and airworthiness policy and related reference data.
- CECOM will generate and approve reference data related to the system and communications infrastructure.
- The OEM and other major suppliers will provide the basic reference data on which the maintenance policy is based (e.g., configuration structure, maintenance task list, task frequencies, and publications data).

MAINTENANCE DATA INFORMATION ARCHITECTURE

As seen in Figure 5-6, maintenance data flow from the maintenance units to the maintenance data center, and from there to the information center, which includes the data repository, analysis, and web-access functions that provide information to both the operational and sustainment base users.

Figure 5-6. AIS Maintenance Data Information Architecture



The information center provides information to two types of users:

- *Operational users* comprise both the operational commanders and maintenance managers. These users require access to live or near-live information about the units and aircraft for which they are responsible. The proposed architecture provides operational users web-based access to the information center from any browser-equipped PC with a web connection. This provides full visibility of all maintenance data for subordinate units and aircraft, and, by way of a range of prewritten queries, provides simple visibility of key operational parameters (such as readiness and estimated time to completion of phase). It must be appreciated, however, that the latency of data presented in web reports will be dependant on the availability of communications from the maintenance units. Wherever permanent online communications exist, the information available from the information center will be live or near live. For units that have sporadic or no online communications, data latency will be dependant on the frequency that data can be transmitted from each unit.

- *Sustainment base users* comprise the Project Office, OEM, and major suppliers. This group's role is the analysis of the collected maintenance data to improve either the prime equipment or sustainment support. To perform the analyses, these users require fleet-wide visibility of maintenance data (although this varies from complete visibility of all aircraft systems to data associated with a particular subsystem) and perform trend analysis on long-term historical data. Therefore, in the majority of cases, data latency due to units with little or no online communications is of negligible concern to the sustainment base.

The information center is on-site where the majority of the analysis work is performed. Therefore, there are two categories of users, those that are close to the maintenance data center and those with a remote connection via either the Web or a dedicated high-bandwidth communications link. The same web-based reporting toolkit is provided for both categories of user.

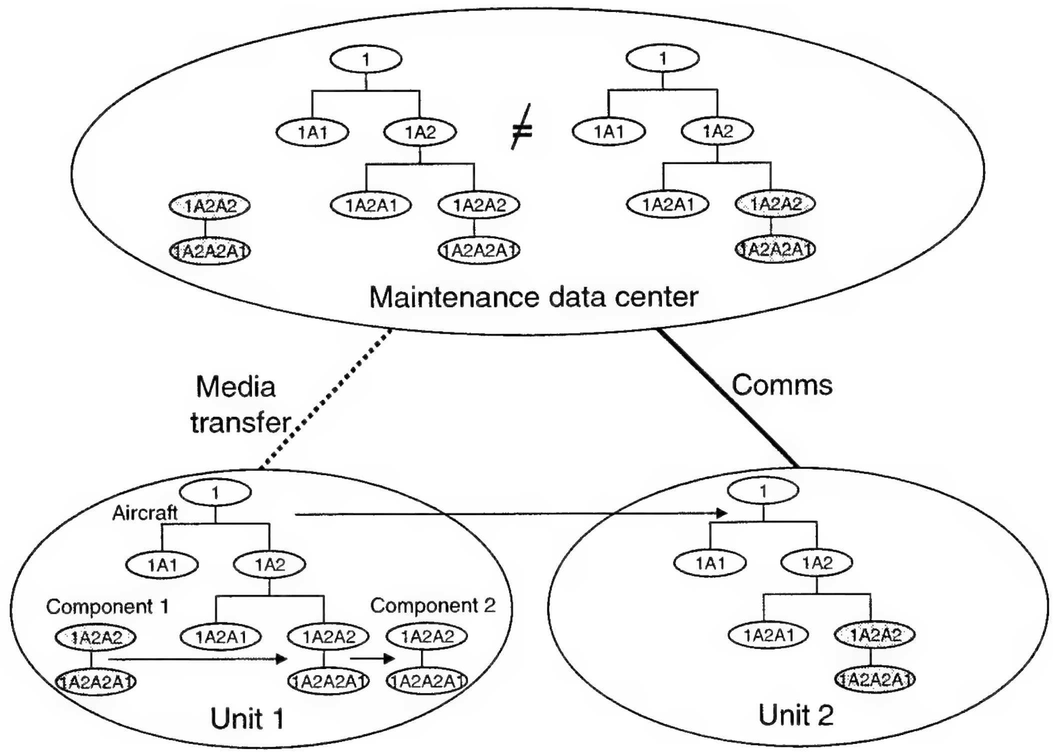
Data Replication

As described previously, within the AIS both reference and maintenance data are replicated between the unit nodes and the maintenance data center. The same reference data are held at all nodes and the maintenance data held at the maintenance data center are the sum of all the maintenance data held at all unit nodes (AVUM, AVIM, depot, and supplier).

The maintenance data replicated from each unit to the maintenance data center must include component installation and removals to maintain the configuration structure of both aircraft and assets. In an established communications environment, this is a relatively simple operation, which is based on the facility's infrastructure with the AIS. In a deployed environment, where communications

may not be available, the replication of data to the maintenance data center is more complex (due to potential differences in data latencies from each unit). Consider the situation shown in the Figure 5-7.

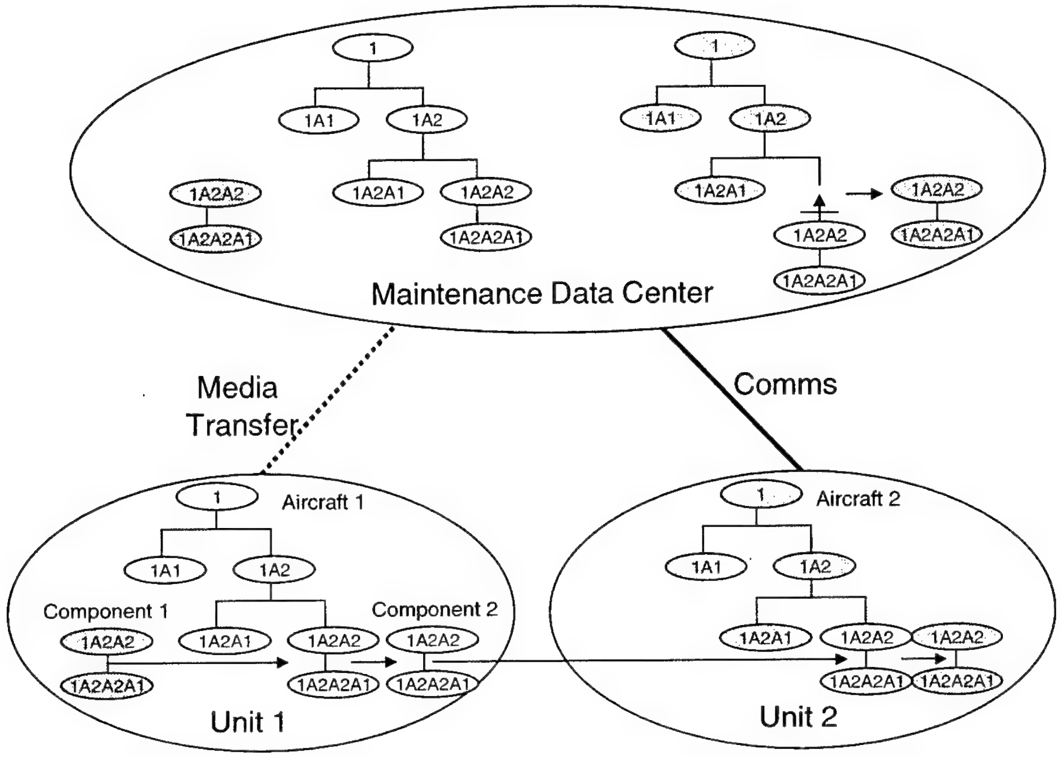
Figure 5-7. Replication Scenario 1



This first scenario shows two units, Unit 1 and Unit 2, and the maintenance data center. Unit 1 is deployed, lacks communications, and is sending data updates to the maintenance data center using a physical medium, which takes time (typically 1 or 2 days). Unit 2 is also deployed, but has communications and is transferring data updates quickly (typically every hour). The scenario starts with an aircraft and a spare component, both located in Unit 1. The aircraft and component configuration files are also held by the maintenance data center, having been replicated on physical media. Work is performed on the aircraft at Unit 1, which involves replacing component 1A2A2 with a spare. The data are carried to Unit 2 and loaded onto Unit 2's server. The presence of the aircraft (and its configuration structure) is then replicated from Unit 2 to the maintenance data center.

Because Unit 2 has communications, the replicated records from Unit 2 arrive at the maintenance data center before the records from Unit 1, which also recorded the replacement of the 1A2A2 component. This situation causes a data clash at the maintenance data center. The same clash would occur if component 2 (originally installed on the aircraft at Unit 1) was transferred to Unit 2 and installed on another aircraft at Unit 2, as shown in Figure 5-8.

Figure 5-8. Replication Scenario 2



In the second scenario, Unit 2 receives component 2 and installs it on aircraft 2 (in place of component 3). The records associated with this installation are replicated to the maintenance data center and arrive before the records associated with the removal of component 2 from aircraft 1. Again, there is a data clash at the maintenance data center, which cannot accept a file recording the installation of component 2 onto aircraft 2, because it still has component 2 fitted to aircraft 1.

The above data replication problems are resolved by the application of transaction sequence numbering at each unit and its subsequent use when applying records at the maintenance data center. However, this widens the impact of any data latencies caused by physical media transfers from deployed nodes. Clearly, if sequence numbers are implemented in the above scenario, the maintenance data center records for aircraft 2 are held off until the records for component 2's removal from aircraft 1 are received at the maintenance data center. Thus, the communications delay from Unit 1 is affecting the fleet's view of aircraft located at Unit 2, which has established communications.

If it is necessary to transfer the recent transaction history of each component or aircraft with the component or aircraft when it is moved to a new unit, then the solution to this problem is achieved by the use of supplementary technology (e.g., either on physical media or a CMB). If this is done, as in the above scenario, then Unit 2 receives component 2's removal record from Unit 1 as it receives component 2. It can therefore transmit this to the maintenance data center with the

component replacement record for aircraft 2, and both records can be applied successfully.

Using this second scenario, the role of supplemental AIT is understood clearly. This scenario also highlights the point made earlier in Chapter 2: combinations of AIT are most likely needed to cover all processes and their contingencies. Another solution to the above scenario could have been to create a local form that manually captures the required information. This could then be entered manually into Unit 2's AIS connection. However, this method drastically increases the potential for data corruption and should be avoided. Therefore, the Con-Ops uses the primary and supplemental AIT approach to achieve success in data transfers in the AME.

THE AUTOMATED MAINTENANCE ENVIRONMENT

The description of the AME is now complete enough to demonstrate the fully functional GTWC assessment, as shown in Figure 5-9. This is the ultimate benefit delivered by the AME to operational commanders. It brings to bear the full capability of unique item identification for automated maintenance management and weapon system support, which are enabled by the combination of AIT, electronic task-based maintenance, integrated-interactive technical data, and total life-cycle management processes. This capability allows operation commanders to accurately assess what it takes to successfully support any mission. Figure 5-10 illustrates the many elements that make up an effective GTWC assessment.

Figure 5-9. The Automated Maintenance Environment

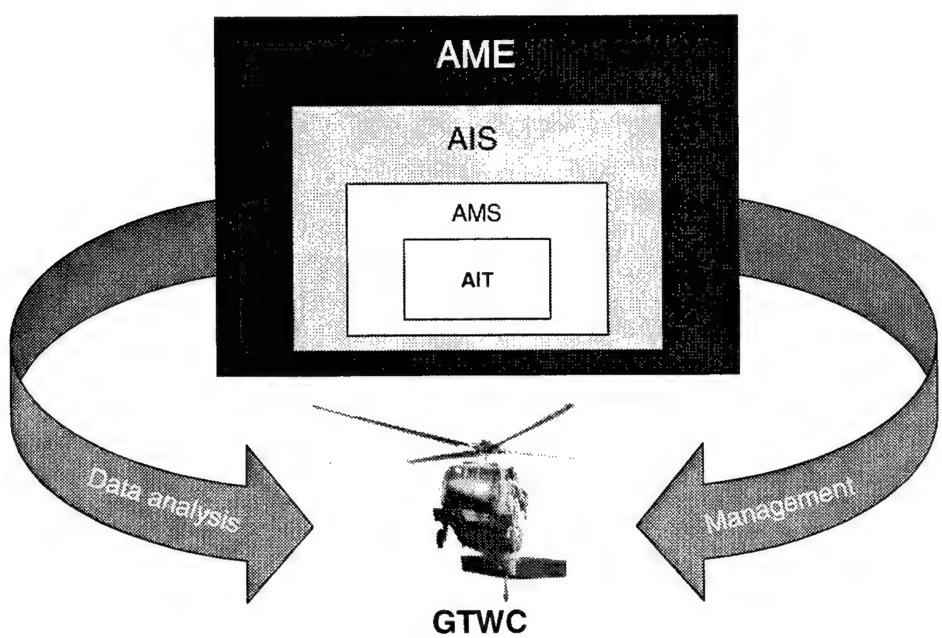
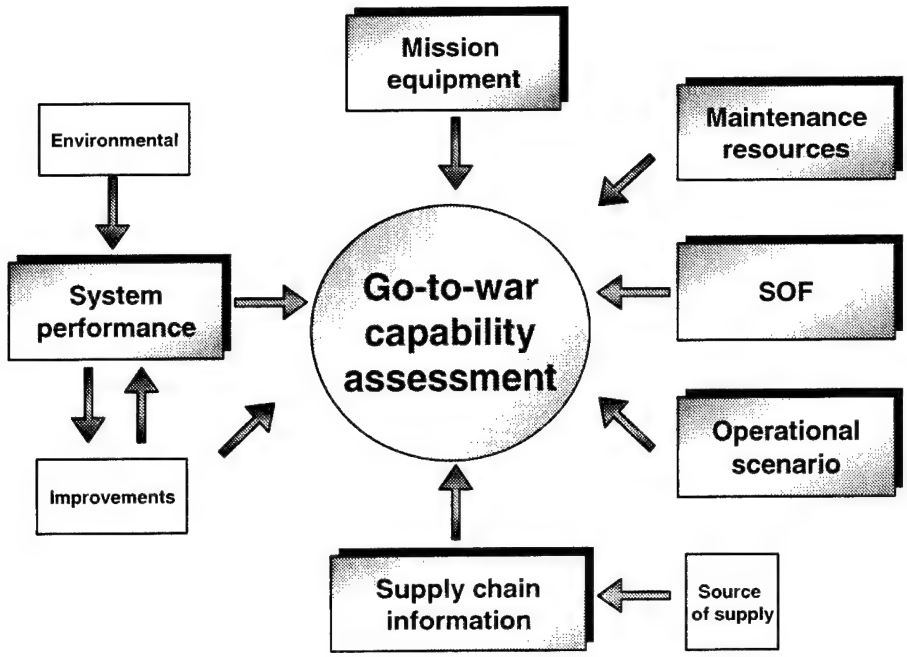


Figure 5-10. Elements of the GTWC Assessment



Operational Scenario

The AME gives the CH-47 operations planner the benefit of detailed and accurate historical information on weapon system performance for a targeted environment. This information ranges from the necessary support resources to the expected maintenance tasks that are required. This information is viewed against variables, such as climate, mission requirements, experience of personnel, and maintenance and supply performance. Some of the information flowing into or processed by the operational scenario element are

- environmental conditions expected;
- duration of mission (operating hours, miles, or calendar days);
- types, numbers, and current configuration of mission equipment (ME);
- current operating times (hours or miles) of ME;
- personnel available and individual performance levels;
- maintenance schedules for ME;
- current maintenance trends based on specific configuration of ME;
- expected maintenance trends of ME based on all the other factors;

- parts required based on expected trend demand and organic repair capability (tools + personnel + authority);
- parts available based on expected trend (organic);
- parts available based on expected trends and priority designator (national inventory stocks, customer wait times, repair cycle times, procurement factors, etc.);
- expected performance of parts available (reliability based on performance or time remaining); and
- costs by classes of supply, operating hour, or mission.

Mission Equipment

At any given time, the AME can provide the commander with a true and current configuration and status of assets without any inspection of the assets themselves. This provides detailed forecasts of the availability of the assets throughout the mission and what resources are required to sustain that mission. Some of the data flowing into or processed by the mission element are

- component configuration;
- weapon system configuration;
- current performance by system, subsystem, or component;
- time remaining on life components;
- time remaining based on trend analysis;
- outstanding or impending safety messages or technical bulletins;
- open maintenance actions;
- impending maintenance actions;
- anticipated time to complete open maintenance actions (personnel + parts + time + tools + training + tasks);
- current percentage of mission capable (based on mission requirements); and
- anticipated percentage of mission capable (+ 24 hours, + 72 hours, etc.).

Maintenance Resources

The commander has accurate data regarding maintenance personnel resources and any future critical losses due to planned rotation. This information includes the levels of expertise and proficiency certification of individuals.

The training files of individual mechanics and maintainers contain a view of capability, by the level and quality of tasks performed. This allows a cost-effective focus on training of maintainers in the field and an assessment of the collective potential of all individuals. Analysis of these data allows institutional training to build a curriculum that accurately meets the ever-changing needs of the field environment. Some of the information flowing into or processed by the maintenance resource element are

- the number of assigned personnel by MOS, skill level, and proficiency certification;
- current or anticipated number of available personnel by MOS, skills level, and proficiency certification;
- expected number of personnel required to sustain a mission at a certain percent mission capability for a specific duration;
- training factors or requirements; and
- collective assessment of capability based on selected individuals or entire unit.

Weapon System Performance

The AME's capabilities to accept, store, and report data from diagnostic systems allows the objective assessment of weapon system performance. This assessment can correlate to a range of environmental factors and aircraft status conditions—including the effect of modifications on the performance. Some of the information flowing into or processed by the weapon system performance element are

- current performance by system, subsystem, or component (based on maintenance history);
- current performance based on diagnostic tests or other monitoring equipment;
- historical perspective of performance based on trends of like items, engineering design, environmental conditions, or individual maintenance history; and
- performance based on environmental conditions.

Safety Messages

The AME improves the effectiveness and reduces the effect on weapon system availability associated with safety messages. The near-real-time visibility of the configuration of each aircraft allows the originator to focus the safety message at only those aircraft affected, without additional inspection required. Because the safety message can be associated with aircraft by the originator, unit maintainers have immediate notice of the requirement for additional maintenance. A further benefit is the feedback to the originator of the level of compliance to the safety message purely by examining the unit status information. Some of the information flowing into or processed by the SOF element are

- outstanding SOF messages open according to specific systems or individual components;
- quality deficiency reports (open or closed) by component type or by specific unique item identifier; and
- results of SOF actions.

Supply Information

The concept provides accurate and reliable data to supply support predictive analysis. This provides historical usage for units, locations and environments in a given scenario. The information allows easy and effective identification of trends for acquisition and procurement functions. It also allows visibility of repair parts from the perspectives of what is available and the planned replenishment time for all shortfall requirements. Some of the information flowing into or processed by the supply information element are

- visibility into the current levels of supplies by part number, NSN, and serviceability (organic or national);
- expected supply levels at a given period of time;
- expected replenishment times (customer wait time, repair cycle time, estimated ship time, estimated delivery time) based on individual units or national averages;
- the correctness (match by usable-on codes) of parts available versus applicability to ME configuration;
- accurate demand history; and
- accurate supply costs.

Architecture Summary

The AIS architecture described in this Con-Ops is essential to obtaining the full functionality envisioned by the AME. As described in this chapter, there are pertinent issues in the relationship between the AIS and the AIT selected and used in the AME.

One of the more critical issues is the decision regarding the design selection of the AIS. The AME, through the design of a well thought out AIS, ushers in new dimensions to all aspects of weapon system management and, therefore, requires strong involvement and guidance from Army leadership. There must be a clear understanding of what is being developed and why.

When deciding what the AIS is and does, the acceptance criteria must be viewed from a new position of involvement. No longer can Army business functions and processes be segmented from Army operational functions and processes. The selection of the AIS must be "right" on both ends of the application. There is little margin for applying the old "use it and then improve it" method habitually applied to new system developments. The AME cannot obtain 100 percent of its full functional capability without a fully functional and effective AIS.

Another critical issue is the selection of primary and supplementary AIT. The primary AIT is directly relevant to the AIS and the method of operation employed by the Army. The supplementary AIT is directly relevant to processes and procedures employed by an individual function. The caveat to a successful AME is the level of sustainment and support of the AIS delivered to the operational users. This requires that use of the AIS evolve into doctrine as it becomes integral to the sustainment and effective operation of a weapon system.

Before implementation of the AME can begin, AIT standards and processes that serve the multi-functional aspect of Army logistics and the AME must be selected. This means AIT must be fully compatible with the data standards and processes used in the AIS. Default standards may work for today's systems, but tomorrow's requirements may find them inadequate to make the final leap into the AME and expensive to change.

As envisioned in the AME, data are in a bi-directional process within the AIS. This data transfer ability is instrumental in obtaining maintenance process efficiencies through the use of integrated, interactive technical data. The technical data processes must be fully integrated and robust enough to support all aspects of maintenance, supply, and sustainment operations. These are automated through the task-based maintenance paradigm, which is considered essential to achieving the full effectiveness and efficiencies of the AME.

Chapter 6
Risk and Mitigation

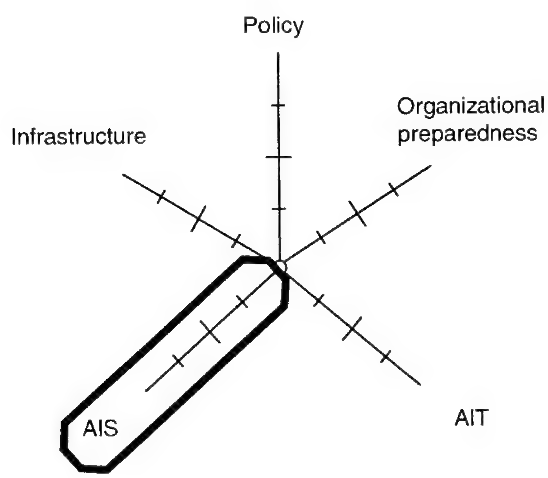
Implementing an automated maintenance environment and its associated application of AIT is, and will continue to be, challenging. This section describes risks and mitigation strategies associated with establishing the AME as defined by the Con-Ops. These risks are all encompassing and consequently do not reflect any unique or specific risk associated to an individual weapon system.

Risks fall into two major categories:

- Those that impact a specific dimension (i.e., policy, infrastructure, organizational preparedness, AIS, and AIT)
- Those that exist across multiple dimensions.

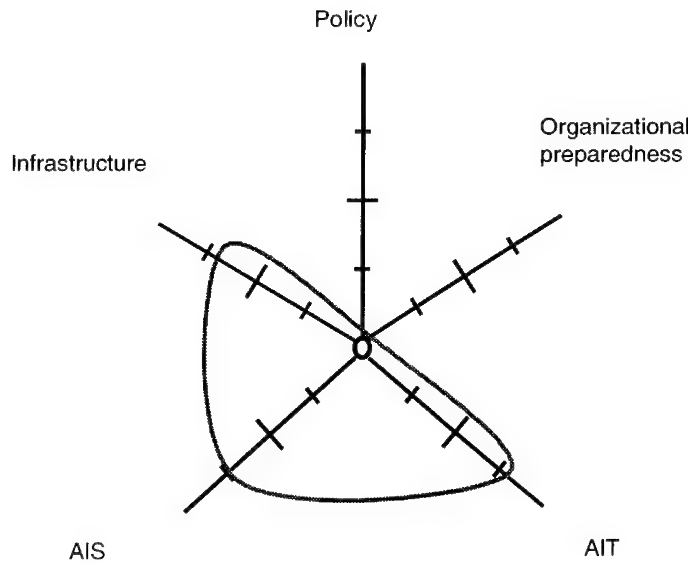
Represented in the context of the state web, specific risks fall along a single dimension; in Figure 6-1 that dimension is AIS.

Figure 6-1. Dimension Risks Fall Along a Single Dimension



The second category of risk is more holistic and includes more than one dimension. These risks are known as synergy risks, and are depicted (see Figure 6-2) in the example as having influence or relevance to three dimensions (i.e., AIT, AIS, and infrastructure).

Figure 6-2. Synergy Risks Fall Along Multiple Dimensions



Synergy risks are manageable but should not be addressed independently of the holistic vision. For Army maintenance, the challenges include

- developing policies and doctrines for implementing automated maintenance;
- gaining user acceptance;
- establishing performance goals;
- assigning roles and responsibilities; and
- analyzing business cases to decide about resources.

Technical challenges include identifying and prioritizing maintenance automation opportunities; establishing an architectural infrastructure; accommodating time-phased, incremental fielding; and creating integration protocols with existing management AISs.

DIMENSION-SPECIFIC RISKS

Policy

RISK 1

Standards are being developed and adopted that satisfy only discrete business process issues (to the detriment of the enterprise vision). For example, a standard that suggests a particular AIT solution focused solely on parts tracking might be incompatible with part life-history management.

Mitigation: Define criteria for a given standard based on the holistic view of AIT as an enabler within the AME. The criteria for a standard should be based on the total life cycle of parts management, including part identification, part tracking, and part history. The standard must be unambiguous, non-proprietary and accepted within the DoD and by industry at large.

RISK 2

Policy does not change relative to the degree of development and implementation of the AME. Technology advances faster than policy changes, and may stymie the development or optimization of the AME.

Mitigation: Organize a policy review and change group with the power necessary to expeditiously effect change within the applicable governing regulations and policies relevant to the AME. The group must have the expertise available to understand and rapidly develop an enterprise perspective of multifunctional logistics and information processes and to implement regulatory change accordingly.

Infrastructure

RISK

Insufficient infrastructure components (e.g., hardware and networking capability) are deployed to support the introduction or continued operation of the AME, which results in degraded performance, user angst and distrust, and increased cost over old business processes. This phenomenon is brought about by ill-conceived or inadequate hardware acquisition and deployment and sustainment strategies that do not align with a holistic vision.

Mitigation: The Army's core competency should be warfighting—not infrastructure deployment. Look to industry as a model for infrastructure. Consider outsourcing select infrastructure components, such as satellite communications and server farms.

Organizational Preparedness

RISK 1

Insufficient emphasis is given to prepare the enterprise to accept, deploy, operate and sustain an AME. The traditional top-down fielding of automated systems—without modifying organizational structures and procedures, and without providing the necessary training—has proven itself an ineffective strategy. Lack of user acceptance will result in users adopting "workarounds," which invalidates data and limits the utility of the information upstream.

Mitigation: Employ spiral development incorporating users in the development process. Equivalent funding must be given to both technical and non-technical

aspects of system fielding. Lack of either can cause the system to fail. These non-technical aspects are essential to change management and include

- pre-fielding familiarization,
- process reengineering,
- training at all levels, and
- otherwise preparing the culture to accept the new system.

RISK 2

The AME, by definition, provides insight to what is happening in weapon systems management in real time. Today, stakeholders can use the lack of objectivity in the current processes to manipulate and report other-than-actual performance. This appears to be engrained in the management's perspective (i.e., varying versions of the truth are accepted). AME processes remove the ability of users to influence report results. If the resulting truthfulness can be used to penalize managers, they will find workarounds, which undermine the benefits of the system.

Mitigation: Education is key. The Army must understand the new paradigm of readiness reporting and weapon system management and react appropriately. A non-retribution environment must be fostered and enforced. Decision makers must use one version of the "truth" to better manage weapon system support, resolve process issues, reengineer processes, and provide training, as necessary. The immediate visibility of support issues provided by the AME should not be used to penalize the users for an emerging negative situation to which they are, or are beginning, to react positively and appropriately.

The AIS

RISK

The selected AIS will not satisfy the preferred business process for the Army. This situation is the result of several factors, including the following:

- Focus on the "as-is" as opposed to the "preferred" business process.
- Lack of a shared holistic vision.
- Lack of user perspective on the part of decision makers.
- Reliance on unsubstantiated and exaggerated claims by AIS providers.
- The cost is prohibitive for a fully functional AIS.

Mitigation: Army executives should decide on, then lead the development of a definitive holistic vision for the "preferred" business processes for the Army. Based on an enterprise business vision, qualified, objective, and unambiguous requirements must be provided to subject matter experts to accurately assess the performance or the design claims of any proposed AIS.

AIT

RISK 1

AIT is deployed without the imposition of an enterprise-wide process for unique identification of parts. This will result in inaccurate or erroneous duplicate data flowing through the AME, and will create the need for considerable manual intervention to resolve data conflicts. This would mean data integrity issues and reduced business benefit in the AME and Army logistics.

Mitigation: The Army, DoD, and industry must collaborate and agree on a standard mechanism to ensure unique serialization of trackable parts.

RISK 2

If selection of an appropriate primary AIT is not based on an analysis of total maintenance business process functions, it will become a liability to the user and to the AME. In developing an AIT solution for the AME, it is important to establish what functionality is required at each interface level—the requirements of a field maintainer differ from those of a national maintainer, and both differ from the requirements of others in the supply chain.

Mitigation: Address maintenance issues directly, including what information is required on the product, read-and-write capability requirements, information accessibility, and the type of information and its currency. Therefore, one technology is not universally acceptable. For example, a combination of read-write and read-only may be appropriate. A variety of needs must be specified as a basis for selecting appropriate technology when data encoding on a product is considered. As a minimum, the following needs should be considered when selecting a maintenance AIT technology:

- Structure, type, and quantity of data
- Density of data to be incorporated into an area on the product
- Read-only and read-write capabilities required
- Longevity of data requirements and environment to be encountered
- Security and data integrity requirements

- Speed and accuracy required for data retrieval
- Cost.

Synergy Risks

Risk 1

If the overall AME vision does not take into account each dimension of the state web during development and implementation, it will be unable to realize all of the benefits without costly rework.

Mitigation: Define a coordinated implementation plan that addresses all dimensions of the AME and fits into the objective business plan. The Army must assign a champion for the AME, with the authority to ensure a symmetrical expansion of the AME is achieved in all dimensions.

Risk 2

The automated maintenance system will be regarded as an extraneous component to weapon system readiness. Failures of the AMS will be considered in isolation to the host weapon system instead of being an integral element of its mission capability and its ability to maintain a mission-effective weapon platform. Moreover, upon an operational unit's deployment, the operational commander must turn off the AMS—for fear that the necessary support will not be provided or sustained.

Mitigation: Develop an automation doctrine that identifies the AMS and AIS as integral components of the weapon system's operating capability. This will drive support policies and architectures that minimize the impact of degraded modes of operation within the AMS/AIS and the constraining parameters of failure modes. In addition, an automation doctrine would align the overall AIS and supporting information systems (e.g., the AMS) with other combat weapon systems, which assigns parity for funding and resources equal to or greater than that of other weapon systems.

Risk 3

The primary AIT selected for use within the AME does not serve the processes and functions external to the AME. This creates gaps in the information flow to and from the AIS. In addition, this could result in a different AIT device being attached to the component during each transition within the logistics or life-cycle process, circumventing cost and process efficiency, and confusing the users.

Mitigation: Establish the most appropriate primary AIT method for all logistics functions—relevant to the overarching goals of Army automated logistics.

One of the main goals of Army automated logistics is to supply the maximum function with the least human intervention. Subsequently, an important goal for AIT is to provide accurate data acquisition capability for maximum utility within the AIS with the least human intervention. To achieve these goals the same data that identify an item during transit, should also identify the item during supply and maintenance processes. The data that identify an item when it is manufactured, and subsequently procured, for Army use, should identify the item when it is removed from service and processed for disposal. Therefore, the selection of a primary AIT method is relevant to the overarching system that it enables. The Army needs to adequately define its information goals and state a requirement for a primary data acquisition method (specifically, AIT) as appropriate for all logistic functions and the AIS.

Appendix
Abbreviations

AIS	automated information system
AIT	automatic identification technology
AMC	Army Materiel Command
AMCOM	Aviation and Missile Command
AME	automated maintenance environment
AMS	automated maintenance system
ANSI	American National Standards Institute
ASA(ALT)	Assistant Secretary of the Army for Acquisition, Logistics, and Technology
ASL	authorized stockage list
AVIM	aviation intermediate maintenance company
AVUM	aviation unit maintenance company
BOM	bill of material
CAGE	commercial activity/government entity
CASCOM	Combined Arms Support Command
CCSS	commodity command standard system
CECOM	Communication and Electronics Command
CM	configuration management
CMB	contact memory button
Con-Ops	Concept of Operations
COTS	commercial off-the-shelf
DELA	Drexler European Licensee Association

DLA	Defense Logistics Agency
DOL	Director of Logistics
DPM	direct parts marking
DRMO	Defense Reutilization and Materiel Office
DSU	direct supply unit
EM	electronic media
GCSS-A	Global Combat Support System–Army
GTWC	go-to-war capability
HEMTT	Heavy Expanded-Mobility Tactical Truck
IETM	interactive electronic technical manual
IGPM	intercept gate parts marking
IMMC	integrated materiel management center
ISO	International Standards Organization
J-DTAV	Joint Directed Total Asset Visibility
JTA	joint technical architecture
KB	kilobytes
LAN	local area network
LOGSA	Logistics Support Activity
MB	megabytes
ME	mission equipment
MH10	materiel handling (standard 10)
MOS	military occupational skills
NGB	National Guard Bureau
NMWR	National Maintenance Work Requirement
NSN	national stock number

OEM	original equipment manufacturer
OMC	optical memory card
OPM	opportunistic parts marking
OPTEMPO	operations tempo
PDF-417	Uniform symbology specification as defined by the Automatic Identification Manufactures (AIM)
PEO	Program Executive Office
PM	program manager
RF	radio frequency
RFID	radio frequency identification
SAMS	Standard Army Maintenance System
SARSS	Standard Army Retail Supply System
SDS	standard depot system
SMPM	seek-and-mark parts marking
SOF	safety of flight
STAMIS	Standard Army Management Information System
TAV	total asset visibility
TRADOC	Training and Doctrine Command
ULLS	Unit-level Logistics System
USAAVNC	U.S. Army Aviation Center
VMAS	vendor marking at source
WAN	wide area network
WLMP	Wholesale Logistics Modernization Program